

APPENDIX N

BACKGROUND INFORMATION ON MARBLED MURRELET FOR THE PALCO HABITAT CONSERVATION PLAN (N1 AND N2)

APPENDIX N

PART 1

**TECHNICAL BACKGROUND:
EFFECTS OF ALTERNATIVE 2 ON MARBLED MURRELETS**

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TECHNICAL BACKGROUND: EFFECTS OF ALTERNATIVE 2 ON MARBLED MURRELETS

Alternative 2/2a represents the proposed action, which includes acquisition of the Headwaters Reserve and implementation of Pacific Lumber Company's Draft Habitat Conservation Plan (Draft HCP) (PALCO 1998). To provide more detailed context for the assessment of affects of Alternative 2/2a, this discussion provides additional background material on existing marbled murrelet habitat and habitat use in the project area relative to the consideration of the HCP's conservation strategy. Also, this discussion provides more detailed information on the expected effects of implementation of Alternative 2/2a and of Assembly Bill 1986, and describes the reasoning used by the Fish and Wildlife Service and Department of Fish and Game in determining possible significance of effects.

Summary

Existing murrelet habitat on PALCO property constitutes a small portion of the ownership, but an important fraction of the habitat in the southern Humboldt bioregion. Few data are available to support quantitative analysis of the relative value of habitats proposed for harvest and preservation, so the agencies must rely on informed judgment and reasoned analysis to evaluate potential effects. Numerous factors suggest that the small uncut old growth stands and the residual stands are of relatively low value to marbled murrelets, even where behaviors indicating occupancy have been observed. Conversely, numerous factors strongly indicate that the large stands of uncut old-growth are high quality habitat for the species.

As proposed in the PALCO HCP, harvest in uncut old growth would occur in stands of small size and lower apparent quality. Harvest of residual stands would remove a larger quantity of acres, but would primarily affect widely scattered stands that are not associated with high quality old growth. The loss of habitat proposed under the Draft HCP would be minor when viewed within larger contexts such as Marbled Murrelet Conservation Zone 4 (MMCZ4) or the 3-state listed range. Importantly, factors related to habitat quality and analysis of detection rates of murrelet occupancy suggest that the impact will be less than that reflected in the simple numeric comparison of occupied habitat acres harvested versus acres preserved.

The protected reserves would include the largest stands of high quality habitat available, and provide for improvement within the reserves during the 50-year period of the incidental take permit. Habitat in reserves would improve as second growth trees within residual stands reach heights that provide surrounding protection for nesting substrate in the residual trees. By the end of the permit period, there will be more closed canopy forest with old growth nesting substrate in the HCP area than exists today, and that habitat will be aggregated near high quality uncut old growth. The amount of MMCA reserve habitat improved would be less than the amount of occupied habitat harvested in strictly numeric terms, but the added value provided in the reserves by aggregating and improving residual habitat in association with high quality habitat would mitigate for the loss of larger amounts of scattered lower quality habitat.

The HCP planning process necessarily involves evaluating habitat quality and risk of habitat loss within a context of maintaining economic opportunity for the applicant. Lacking strong data on the relationship between habitat characteristics and marbled murrelet reproductive success, the planning effort relied on basic conservation principles, directing timber harvest to lower quality habitat, preserving high quality habitat in large blocks, and providing capacity for habitat improvement. The proposed action is consistent with those principles. The proposed action also is consistent with the direction of the Marbled Murrelet Recovery Plan, because it brings important habitat into public ownership, preserves most of the high quality occupied habitat remaining in PALCO ownership, and provides for improvement of reserve habitat in a key portion of the species' range. If fully implemented, the measures prescribed by Assembly Bill 1986 (i.e., the purchase of the Owl Creek and Grizzly Creek MMCAs by the State of California) would further increase protection for the marbled murrelet under the HCP.

Marbled Murrelet Habitat On The PALCO Ownership And In The Southern Humboldt Bioregion

The amounts of uncut old-growth and residual stands existing on the ownership and in the southern Humboldt bioregion are summarized in Table N.1-1. The following discussion describes the attributes of the different stand types, their value as habitat, and the potential effects of their harvest.

Old-growth Stands

Stands of uncut old-growth include those dominated by redwood and others dominated by Douglas fir. (In this discussion, uncut old-growth redwood stands are distinguished from "residual stands", which have had a portion of the old trees removed.) In general, redwood stands are found at lower elevations in areas influenced by fog during the summer months. Uncut old-growth redwood stands occupy approximately 5,140 acres (2.5 percent) of the current ownership, while old-growth Douglas fir stands occupy approximately 8,519 acres (4 percent) of the ownership. About 4,621 acres of the uncut old-growth are within the boundaries of areas designated as critical habitat for the marbled murrelet by the USFWS (61 Federal Register 26256).

As a result of past harvest patterns and the relatively recent protection under CESA and ESA of old-growth stands occupied by marbled murrelets, the largest remaining uncut old-growth redwood stands are primarily found in the northern 1/3 of the PALCO property (see EIS/EIR map at Figure 3.9-2). The largest contiguous block of remaining old-growth is the Headwaters Forest (including the Elkhead Springs stand), which contains about 3,117 acres of uncut old-growth (61 percent of the uncut old-growth redwood on the property). Outside the Headwaters, the largest remaining grove of uncut old-growth is the 393-acre Allen Creek stand. Outside the Headwaters, most of the old-growth stands on the property have been fragmented by harvest, and many patches have high ratios of edge to interior forest. About 20,310 acres of uncut old-growth stands, mostly dominated by redwood, exist in the two neighboring state parks, Humboldt Redwoods State Park (HRSP) and the much smaller Grizzly Creek State Park (GCSP). Over 98 percent of this state park old-growth is in HRSP.

The remaining uncut old growth redwood stands often contain over 30 old-growth trees per acre and, although small openings do occur, often exhibit 80 to 100 percent canopy closure. Many old-growth trees exceed 200 feet in height.

Residual Stands

Stands of residual old-growth, in which old-growth trees remain after selective harvest of many old-growth trees from within the stand, occupy approximately 12,447 acres (6 percent) of the ownership. The residual stands are widely scattered across the ownership (see EIS/EIR map at Figure 3.9-2), and rarely occur in large contiguous stands, because they have been internally fragmented by more recent clear-cutting. About 11,852 acres (95.5 percent) of the residual stands contain fewer than 15 old-growth trees per acre. About 4,658 acres (37 percent) of the residual stands are within the boundaries of designated critical habitat units on the ownership. Outside of PALCO's ownership, about 3,354 acres of residual stands exist in the parks, almost 90 percent of which are in HRSP.

Habitat In The Range Of The Marbled Murrelet

Amounts of habitat in wider regions of the listed range of the marbled murrelet are described in Table N.1-2

Habitat Use By Marbled Murrelets

“Occupied behavior”

The following discussion is based on information regarding marbled murrelet behaviors reported in several published works (Ralph et al. 1995, Nelson and Hamer 1995, Divoky and Horton 1995) and on personal communications with one of these authors (S. K. Nelson, Oregon Cooperative Wildlife Research Unit, Oregon State University, 9/15/98). Determination that a timber stand is occupied by marbled murrelets is based on observation of certain behaviors. Actual observation of a nest or of murrelet eggshell fragments on the ground is relatively rare. But several types of murrelet behaviors are strongly associated with forest stands containing known nest sites. These behaviors include circling over a timber stand, flying below the foliage of trees in a stand, or landing on branches, and are collectively called “occupied behaviors.” While it possible that such behaviors might also be exhibited by non-breeders (for instance, in “prospecting” for nest sites), the great preponderance of experience and opinion of biologists indicates that these behaviors are associated with breeding sites. Therefore, the observation of “occupied behaviors” is a key determination in the assessment of the potential value of a timber stand and of potential impacts of management activity.

Survey protocols recommended by the Pacific Seabird Group, an association of researchers, are used by the regulatory agencies and project proponents to determine whether habitat is occupied (Ralph et al. 1994). These protocols require that prescribed numbers of surveys be conducted before it can be conclusively stated that a stand is not occupied. Often, stands of apparent habitat

that are determined to be unoccupied are harvested soon thereafter, so there are relatively few existing old-growth stands that are regarded as conclusively unoccupied, unless there are other constraints on their harvest. Thus, most existing old-growth stands are classified either as occupied or as inadequately surveyed.

One difficulty associated with the use of occupied behaviors in evaluating stand value is interpreting what portion of a stand might actually be occupied where survey stations do not adequately cover a stand. Generally, it is assumed that all apparently suitable habitat that is contiguous and within ½-mile of an occupied station is occupied. The HCP Scientific Panel noted that this assumption might result in over-estimates of occupied habitat (see Scientific Panel notes of May 26 and 27, 1998, in Vol. IV, Part B, Sec. 7, in PALCO 1998), but lacking other standard methodology, the habitat figures in this discussion are computed on the basis of the same assumption.

Also, the detection of occupied behaviors does not constitute a count or census of birds. The rapid flight of the murrelets, combined with difficulties of observation in heavily forested areas under variable weather conditions, render counting of murrelets in the forested environment impossible with current techniques. (All current population estimates are derived from counts at sea.) Therefore, there currently is no available method for determining the numbers of murrelets using a particular stand, or comparing numbers among stands.

Use of Uncut Old-growth by Marbled Murrelets

Most of the uncut old-growth Douglas fir stands on the ownership are not believed to be occupied by marbled murrelets. Surveys conducted at Douglas fir stands in the Bear-Mattole area have resulted in only a few scattered detections and no indication that stands with apparently-suitable structure are occupied by marbled murrelets (see Vol. IV, Part B, Sec. 2 in PALCO 1998). Marbled murrelets have been located at a few Douglas fir stands elsewhere on the property, mostly in areas adjacent to old-growth redwood.

In contrast, most of the remaining stands of uncut old-growth redwood on the ownership are known to be occupied by marbled murrelets. On the PALCO ownership, about 4,230 acres of uncut old-growth are known to be occupied, with about 910 acres that have not been adequately surveyed. Most uncut old-growth stands are believed to provide high quality breeding habitat for murrelets. These stands provide large numbers of potential nesting platforms (large limbs and deformities) and extensive protective cover. The only obvious factor that may diminish the quality of this habitat on the ownership is the relatively high amount of edge, which results because many of the remaining stands are small, disconnected remnants of once-extensive stands. The edge factor may be especially important in very small stands, which have little or no acreage that is not in proximity to the edge of the stand.

Edge effects are believed to include increased access for avian nest predators (which include jays, ravens, and great horned owls) and increased effects of weather. Numerous authors have discussed the influence of edge and edge-related predation on marbled murrelets and other birds, and generally it has been maintained that edge effects may be a significant factor in the apparent

low reproductive rate of marbled murrelets (e.g., see Nelson and Hamer 1995, and literature cited therein). However, occasions of successful murrelet reproduction have been observed in exposed sites with high degrees of edge (S.K. Nelson, Oregon Cooperative Wildlife Research Unit, Oregon State University, personal communication, 9/15/98). Recently, preliminary results from a study specifically designed to address the question have indicated that proximity to human habitation is a more important predictor of avian nest predation than edge (Marzluff et al. 1998). Based on the preponderance of existing information, the agencies have continued to consider edge as a negative factor in habitat quality in our assessment of the quality of habitat and effects proposed by the Draft PALCO HCP.

On HRSP, the quality of old-growth redwood stands for marbled murrelets is uncertain. In lowland areas with high concentrations of old-growth, such as Bull Creek, the occurrence of occupied behaviors is commensurate with that on the PALCO ownership. However, in upland areas of the park, uncut old-growth stands are more scattered, have lower density of old trees, and are more subject to high summer temperatures. Thus, the upland old-growth is believed to provide lower quality habitat. This conclusion is at least partially supported by marbled murrelet survey results from the park. Most surveys in upland areas of the park have not detected occupied behaviors (see map at Vol. IV, Part B., Sec. 1, Fig. 5, in PALCO 1998). Most of the upland survey stations have not been surveyed enough times to state conclusively that murrelets do not occupy the area, but because widespread low-intensity surveys have not detected the species, it is reasonable to suspect that murrelet use of the upland areas is at best low. Based on existing information, it appears that fewer than 5,000 acres of the park provide high-quality habitat for the species.

Use of Residual Stands by Marbled Murrelets

Marbled murrelets are known to occur within numerous residual stands on the PALCO ownership. Occupied behaviors have been observed in residual stands totaling approximately 5,517 acres. About 6,930 acres of residual stands have not been surveyed to a degree adequate for drawing conclusions as to their occupancy by murrelets. Most, though not all, of the observations of occupied behaviors in residual stands have been in stands associated with uncut old growth. On HRSP and GCSP, occupied behaviors have been observed in residual stands totaling 96 acres and 25 acres, respectively. The remainder of the residual stands in the parks have not been adequately surveyed.

The observation of occupied behaviors indicates that at least some residual stands are of value to marbled murrelets. However, the actual degree of importance of murrelet use of residual stands is uncertain. Direct comparison of detection rates among residual and uncut stands may not be indicative of the actual degree of use, because the relatively high detection rate in some residual stands may be biased upwards by the much higher visibility within these stands. Statistical evaluation of detection probability based on 1992 surveys in three heavily surveyed stand types found that the probability of detection was highest in uncut redwood old-growth, lowest in uncut mixed redwood and Douglas fir old-growth, and intermediate in residual old-growth with less than 50 percent cover (White 1998; see Vol. IV, Part B, Sec. 11 in PALCO 1998). However, this analysis noted that differences in "observability" between stations were not adequately addressed.

No direct evidence of nesting (such as eggshell fragments or fecal rings) has been found in residual stands, but this lack of evidence may reflect a low degree of effort to locate such evidence. Thus, assessment of the quality and importance of residual stands must be largely based on assumptions and reasoned analysis rather than actual data.

Throughout the Pacific Northwest and northern and central California, most murrelet nests documented to date have occurred in stands with large numbers of large trees and multiple canopy layers (Hamer and Nelson 1995). For instance, in nest stands in Oregon and Washington, the mean number of trees over 17" dbh per acre was 37.9 (Hamer and Nelson 1995). In the Coast Range of Oregon, Grenier and Nelson (1995) found occupied stands with as few as 6 trees per acre over 32 inches dbh, but the mean number of trees per acre over 32 inches dbh was 22.5. Many of these sites were in uneven-aged forests that had not been subject to management, and all had multiple canopy layers. Canopy cover near the nest tree was often low, perhaps resulting from small openings that may provide access, but overall stand density was usually high. According to Grenier and Nelson (1995), "...suitable nesting habitat likely includes complex structure, high densities of large trees, large nesting platforms, and hiding cover;" and "Nests were located in large trees with large platforms and high vertical canopy cover." While nests have been located in Oregon in scattered remnant trees amid younger stands, they usually occur where deformities such as dwarf mistletoe provide platforms beneath vertical cover (S.K. Nelson Oregon Cooperative Wildlife Research Unit, Oregon State University, personal communication, 9/15/98). Miller and Ralph (1995) found density of dominant and co-dominant trees to be a significant and positive variable related to occupancy of stands by murrelets in California.

Specific data for evaluation of PALCO residual stands relative to many of these characteristics do not exist. However, several physical factors suggest that the residual stands on PALCO lands provide habitat that is of lower quality than uncut old growth for supporting murrelet reproduction. Three primary types of quantitative information are available to assist in judging the present quality of marbled murrelet habitat in residual stands, and the potential that substantial improvement in habitat quality could occur in these stands during the 50-year permit period. These include data on the timber volume density (expressed in thousands of board feet per acre, or mbf/ac), current density of cover provided by residual trees (measured by percent canopy closure in the overstory), and the height of second-growth stands beneath the residual trees. In general, the agencies assume that the best habitat in residual stands would be provided where the highest timber volume and maximum canopy closure among the residual overstory (which would result from higher density of large residual trees and/or large limb structure) is combined with maximum height of the second-growth stand beneath the residual overstory.

Timber volume density on the PALCO ownership is detailed in Appendix N, Part 2, Table 1.B. To summarize, about 28 percent of the acres of residual stands contain less than 25 mbf/ac, about 68 percent contain between 25 and 50 mbf/ac, and only about 4 percent contain more than 50 mbf/ac. These volume densities are in marked contrast to uncut old growth stands, in which 90 percent of the acres exceed 100 mbf/ac, and 50 percent exceed 150 mbf/ac.

Because a low number of trees remain, most of the residual stands have low canopy closure. About 59 percent of the residual acres on PALCO lands have a canopy closure of less than 25 percent, and less than 2 percent of the residual acres have canopy closure over 50 percent. According to PALCO, the harvest methods that resulted in today's residual stands removed the largest trees with the most timber volume, and left smaller trees with more likelihood of future growth. The smaller trees left unharvested (which are still large trees by most standards) often appear to have fewer of the large limbs and deformities that murrelets use for nesting. (See notes from HCP Scientific Panel May 26 and 27, 1998; in Vol. IV, Part B, Sec. 7, in PALCO 1998). Thus, with fewer trees per acre and fewer nest structures per tree, residual stands probably have only a fraction of the nesting opportunities present in an uncut stand.

Most known murrelet nests in redwood stands are over 120 feet above the ground ($n=10$, mean=154 feet, $SD=36$ feet, range 108-223 feet) (Hamer and Nelson 1995), so to provide protective cover, surrounding second growth must exceed that height. Where the overstory residual trees are sparse, or where the understory second-growth does not reach above 120 feet in height, habitat for murrelets is assumed to be of lower quality. Under very good conditions, some young dominant redwoods may exceed 120 feet at 40 years of age, but most stands would be expected to grow somewhat slower than this rate (Lindquist and Palley 1963). Although conditions vary, on the PALCO ownership it is reasonable to expect that most second-growth redwood stands on the ownership would not exceed 120 feet in height until they are over 60 years of age (T. Robards, CDF, pers. comm.). Because the partial harvest in many of the residual stands occurred in recent decades, there currently are few residual stands where the second-growth exceeds 100 feet in height. Only about 695 acres of such stands (less than 6 percent of the total residual stands) currently exist on the ownership. In other stands totaling about 4,036 acres (32 percent of the residual stands), the second growth beneath the residual trees is now between 60 feet and 100 feet in height. Conditions of canopy closure and second growth in residual stands are detailed in Table N.1-3.

In most residual stands the scattered distribution and low canopy closure among the remaining trees result in very little apparent protection for existing nesting platforms. Such locations appear to provide easy access for avian nest predators and reduced protection from the elements. Thus, even if nesting is attempted in residual stands, the likelihood of success is probably lower than in uncut old-growth. Assessing all of the above factors, the agencies assume that the residual habitat is of considerably lower value than uncut old-growth, even where occupied behaviors have been observed in residual stands.

Another aspect of residual stands that must be considered is their value as future marbled murrelet habitat. Stands of pure old-growth habitat probably cannot be produced for several hundred years. However, by providing protective cover among the remaining old trees in residual stands, the regeneration of second-growth may improve the quality of the residual habitat within a few decades. The rate of continuing growth of these stands is highly dependent on local site conditions, and generalizations about anticipated growth must be viewed with caution. With that caveat, based on modeling of stand growth on typical PALCO sites, most of the trees in stands that are currently between 60 and 100 feet in height should exceed 100 feet within the next 50 years if left unharvested. Over 45 percent of the trees should exceed 120 feet

in height, and a few would have reached 150 feet (based on CRYPTOS modeling by T. Robards, CDF, personal communication, 8/25/98). At that point, the second growth should be providing cover for potential nesting sites in the residual trees, resulting in improved habitat quality in the residual stand. Under better site conditions, such as in riparian zones, benefits to residual stands would occur sooner and develop further within the next 50 years.

The condition of second-growth within residual stands is particularly important where residual stands are found near occupied old-growth stands, because the old-growth stands could provide the source of murrelets for re-occupation of the improving residual habitat. Residual stands with well-developed second-growth that neighbor old-growth stands offer the highest available potential for habitat improvement within the life of the HCP. Therefore, in evaluating potential future habitat, the agencies regard residual stands near occupied old-growth as substantially more valuable than residual stands that are isolated from old-growth stands. All of these factors have been considered in designing the Draft HCP and in evaluating the potential effects on marbled murrelets.

Effects Of The Proposed HCP (Alternative 2) On Marbled Murrelets

The potential effects of Alternative 2 and 2a (which includes the acquisition of the Headwaters Reserve and implementation of the draft HCP submitted by PALCO in July, 1998), and of implementation of modifications prescribed by Assembly Bill 1986, on amounts of uncut and residual old-growth are summarized in Table N.1-4. The following discussion further describes those effects. In many cases, the actual acreage harvested would be somewhat less than those quantified herein because acreage within these stands that would be left unharvested under the aquatic strategy has not yet been calculated and subtracted.

Alternative 2 and 2a

Depending on which of the options (Owl Creek or Grizzly Creek) PALCO decides to harvest, either 818 acres or 619 total acres of uncut old-growth redwood would be harvested under this alternative. Among all the old-growth authorized for harvest, the largest contiguous acreage harvested would be that in the selected option (317 acres in Owl Creek, which include 19 acres dominated by Douglas fir, or 117 acres in Grizzly Creek). Uncut old-growth in the Owl Creek area has been extensively fragmented by past harvest (see Map # 9 in Vol. IV, Part B, Sec. 12, in PALCO 1998), and may be subject to edge effects. Although there are no quantitative data available, agency biologists have noted that the uncut old-growth in the Owl Creek appears to be somewhat younger than other old-growth stands on the ownership, and appears to have a lower occurrence of large limbs and deformities suitable for nesting than exhibited in other old-growth stands. The uncut old-growth on PALCO ownership in the Grizzly Creek area is also fragmented into several small stands separated by residual stands (see Map 10 in Vol. IV, Part B, Sec. 12, in PALCO 1998). Therefore, the agencies regard the Owl Creek and Grizzly stands of uncut old-growth as the least valuable of the large uncut stands outside the Headwaters Forest.

Other harvest of uncut old-growth would be in even smaller scattered stands, the largest of which are the Monument - Dean stand (about 89 acres) and the Nanning Creek stand (about 64 acres).

These stands are isolated from other areas of old growth. Roughly 50 percent of the uncut old-growth acres harvested would come from scattered stands of less than 60 acres each. These small stands proposed for harvest have little interior forest and high ratios of edge, and are thus regarded as having relatively low value for murrelets in comparison to larger stands.

Depending on the option selected for harvest, either 8,855 acres (harvesting the Owl Creek option) or 9,146 acres (harvesting the Grizzly Creek option) of residual stands would be harvested. In either case, about 27 percent of the residual acreage that would be harvested is known to be occupied by murrelets, and the remainder has not been adequately surveyed.

In general, much of the residual that would be available for harvest appears to be of low quality. About 38 percent of the total residual acres available for harvest would be in the lowest density stands with less than 25 mbf/ac. About 96 percent of that lowest density class would be made available for harvest, maximizing the harvest volume contribution from the stands that appear least valuable in terms of murrelet habitat. Some of the highest quality residual stands that would be harvested might be the 695 acres (8 percent of the residual that would be harvested) that have an understory over 100 feet high beneath the crowns of the residual old-growth trees. However, most existing stands of this description are quite small (the average patch size in this stand type is about 15 acres), and most are not associated with large old growth stands. None are within the boundaries of designated critical habitat. Consequently, most of the existing stands of this description probably are of relatively low value to marbled murrelets.

In another perspective, fairly high quality among residual might be represented in stands with greater than 25 percent canopy closure and second growth over 60 feet high. About 947 acres (about 11 percent) of the residual available for harvest is in this category. In contrast, the largest acreage of residual available for harvest is that category with less than 25 percent canopy closure and second-growth less than 60 feet high. Comprising about 3,091 acres (36 percent of all the residual available for harvest), it probably represents the lowest quality of all the residual stands.

High degrees of fragmentation and isolation from old-growth are evident in visual examination of the distribution of most of the residual stands that would be harvested (see EIS/EIR map at Figure 3.9-2). Many of these small stands are suspected to have little value for murrelets due to high amounts of edge.

About 2,040 acres, 25 percent of the residual available for harvest, are in 6 stands of over 200 acres each. Observations of murrelet occupied behavior have occurred in 3 of these stands, but the rates of occupied detections have been much lower than in uncut old growth (Ralph et al. 1998; see Vol. IV, Part B, Sec. 10 in PALCO 1998). These 3 stands include (using names assigned by Ralph et al. 1998) Grizzly-Bemis (non MCA), Jordan, and North Fork Elk SE. At 566 acres, the latter area (which is also known as the Turkey Foot area) is the largest contiguous residual stand that would be available for harvest. This stand is characterized by a fragmented, linear configuration with high amounts of edge, and is not associated with any old growth stands. It is the only one of the six that is within designated critical habitat.

The remaining 3 of the largest 6 residual stands have not been adequately surveyed. One is in the upper portion of the Jordan Creek drainage (412 acres), and one is in the lower Bear Creek drainage (244 acres). The third is in an isolated parcel up the Eel River over 10 miles from the remainder of the ownership. Because it is so far from the coast, the latter stand (205 acres) is probably of very low value to murrelets.

Other areas of residual available for harvest that exhibit some value for murrelets include 2 areas of mixed stands that are contiguous with occupied residual in MMCAs. These two areas (one of about 110 acres and one of about 160 acres) are adjacent to the "Below Road 7 and 9" MCA stands (see Map 4 in Vol. IV, Part B, Sec. 12, in PALCO 1998). In this area, unlike most other MMCAs, the proposal would dissect contiguous stands, leaving substantial acreage out of the reserve. Murrelets have been detected in these areas without indications of occupied behavior, but the stands have not been surveyed adequately to conclude that they are unoccupied. The majority of these 2 stands available for harvest have canopy closures of 25 to 50 percent, so they are among the better quality residual habitat type. Both are within designated critical habitat. Because of their location and relatively good quality, these might represent the most valuable residual available for harvest.

The primary variables to be considered in evaluation of effects of habitat removal are the amount and value of habitats removed versus the amount and value of habitats retained. For evaluation of the effects of the Draft HCP, habitat acreage can be only partially quantified, because a substantial portion of the residual habitat has not been adequately surveyed. Habitat value cannot be quantified, although as discussed above, there are strong indications that habitat quality is quite variable. Therefore, many assumptions must be applied to any attempt to provide a quantitative context to effects. Many different combinations of assumptions were evaluated in the assessment of potential effects of implementation of Alternative 2/2a on marbled murrelets. Several of these are presented in Appendix N, Part 2, Table 5A-5J, which was prepared by consultants to the California Resources Agency (the TRA analysis).

Because existing information on the extent of habitat used in HRSP is incomplete, different assumptions regarding the amount of habitat in the park have been incorporated into alternate methods of evaluating the impacts to marbled murrelets. Because the amount of habitat in HRSP is possibly substantial within the context of the bioregion, assumptions regarding that amount are important in evaluating the impact of the proposed action. In the TRA analysis, the amounts incorporated range from 20,310, which is the total amount of old-growth found in the parks, to 4,250, which is the amount of uncut old-growth in contiguous stands within ½ mile of occupied survey stations in the parks.

Similarly, because information is incomplete regarding the amount of residual habitat used by murrelets, alternate methods of assessing effects incorporate different assumptions regarding this factor. Because the acreage of residual stands proposed for harvest constitutes the majority of the acres of murrelet habitat that will be impacted, different assumptions regarding residual habitat substantially affect the evaluation of effects. In the TRA analysis the highest estimate of residual acreage occupied by murrelets assumes that all of the residual on the property is occupied, while the lowest estimate includes all of the known occupied residual stands plus 25 percent of the

inadequately surveyed acreage of residual stands. The estimate that about 25 percent of the inadequately surveyed residual stands may be occupied is based upon the recent experience of agency timber harvest review biologists (K. Moore, California Dept. of Fish and Game, personal communication).

Drawing from the data in Appendix N, Part 2, the following discussion details other potential outcomes, encompassing a range of possible effects of implementing Alternative 2/2a..

Conservative Worst Case

This method of assessment describes a very conservative worst case in terms of effects to murrelets. In this case, all old-growth and residual acres on Pacific Lumber lands are assumed to be occupied and of equal value, comprising a total of about 17,585 acres. Acreage occupied on state park land is assumed to be limited to contiguous old-growth within a half mile of survey stations where “occupied behaviors” have been observed, totaling 4,250 acres. Thus, these assumptions assign the maximum value to the PALCO lands, and minimum value to other habitat in the bioregion. Under these assumptions, the total occupied habitat in the southern Humboldt bioregion is 21,835 acres.

Under these assumptions, if the Owl Creek option were harvested, the total acreage removed (9,532 acres) would constitute about 44 percent of the existing total in the bioregion, and if the Grizzly option were harvested, the acreage removed (9,765) would constitute about 45 percent. This would constitute about 7 percent of the marbled murrelet habitat in MMCZ 4, and about 1.4 percent of the habitat in the 3-state range. If AB 1986 were fully implemented and neither Owl Creek or Grizzly Creek were harvested, the loss would be equivalent to about 42 percent of the bioregion habitat, about 7 percent of MMCZ4 habitat, and about 1.3 percent of the 3-state habitat.

In combination, these assumptions are believed to represent the worst possible outcome for marbled murrelets that might be contemplated from implementation of Alternative 2. However, the agencies do not believe these assumptions are realistic, nor that this degree of effect is likely to occur. As described above, experience in the field suggests that a minority of the unsurveyed residual acres are likely to be occupied, and based on numerous physical factors, it is highly unlikely that the occupied residual provides habitat equivalent to the quality of the uncut old-growth on an acre-per-acre basis. Also, it is likely that complete surveys would result in location of additional occupied acres in the parks, raising the total of protected habitat and reducing the proportional impact. (In fact, preliminary results from 1998 surveys indicate that the number of occupied park acres will be adjusted upward.)

Best Case

This method of assessment describes what may be the most optimistic case in terms of effects to murrelets. In this case, all residual acres on Pacific Lumber lands are assumed to have no value for murrelets, even if they have been found to be occupied. Therefore, harvest of residual would have no effect on the species. All uncut old-growth on the ownership is assumed to be occupied and of equal value, comprising a total of about 5,139 acres. Acreage occupied on state park land is assumed to include contiguous old-growth within a half mile of survey stations where “occupied behaviors” have been observed. Additionally, 25 percent of the inadequately surveyed old-growth acres in the parks are estimated to be occupied, resulting in total of about 8,265 acres of occupied residual habitat. Thus, these assumptions assign value only to old-growth on the PALCO lands, and to an acreage of old-growth on park lands that may be optimistically high. Under these assumptions, the total habitat in the southern Humboldt bioregion is about 13,404 acres.

Under these assumptions, if the Owl Creek option is harvested, the acreage of uncut old growth habitat removed (818 acres) would constitute about 6 percent of the total of such habitat in the bioregion, and if the Grizzly option is harvested, the acreage removed (619 acres) would constitute less than 5 percent of such habitat. If neither are harvested under full implementation of AB 1986, less than 4 percent of the habitat in the bioregion would be harvested. Following adjustment of the totals in wider regions to reflect the assumptions, harvest including Owl Creek would constitute removal of less than 1 percent of the marbled murrelet habitat in MMCZ 4, and less than 0.2 percent of the habitat in the 3-state range.

These assumptions combine to illustrate what are probably the minimum effects that could be expected to result from implementation of Alternative 2. The agencies regard these assumptions and effects as optimistic. The observed behaviors of the murrelets indicate that the residual stands are of least some value, and neither survey results nor agency biologists’ field experience support the relatively high hypothetical acreage of park habitat. While this scenario is probably not realistic, it does illustrate that the effect on high quality habitat would be small.

Reasonable Conservative Estimate

Numerous scenarios can be constructed to demonstrate intermediate effects that would be regarded as more reasonable and likely than either of the two previous cases. Several such scenarios, based on interchanging various assumptions regarding old-growth and residual habitat on PALCO land and in the parks, are presented in the TRA analysis in Appendix N, Tables 5A through 5J. Unfortunately, extensive data needed to support a more precise quantitative analysis currently do not exist. This is particularly true regarding the relative values of residual and old-growth. While application of a reasonable set of assumptions would be expected to yield a reasonably likely outcome, such results must be recognized as an estimate based on informed judgment rather than analysis of quantitative data.

With that proviso, the following assumptions are believed to provide a reasonable initial context for approximating the likely effects of implementation of the proposed HCP. For this estimate,

all old-growth on the ownership (5,139 acres) is assumed to be occupied, as are the acres of residual known to be occupied (5,517). Of the inadequately surveyed residual acreage on the ownership, 25 percent (1,733 acres) is also assumed to be occupied by murrelets. Lacking any means of determining a weighting factor, occupied residual acres are assumed to be equal in quality to old-growth. Thus, the total occupied habitat on the property is assumed to be about 12,389 acres. Acreage occupied on state park land is assumed to include 4,250 acres of contiguous old-growth within a half mile of survey stations where “occupied behaviors” have been observed, as well as the 122 acres of residual known to be occupied in the parks. Thus, park habitat totals 4,372 acres. Under these assumptions, the total amount of occupied habitat in the southern Humboldt bioregion is about 16,761 acres.

Under these assumptions, if the Owl Creek option were harvested, the acreage of assumed occupied habitat removed (4,761 acres) would constitute about 28 percent of the total habitat in the bioregion, and if the Grizzly option were harvested, the acreage removed (4,769 acres) would also constitute about 28 percent. Following adjustment of the totals in wider regions to reflect the assumptions, harvest including Owl Creek would constitute removal of about 7 percent of the marbled murrelet habitat in California, about 3.8 percent of the habitat in MMCZ 4, and about 0.7 percent of the habitat in the 3-state range. If AB 1986 is fully implemented, the amount of assumed occupied habitat removed would be about 3,954 acres, which is about 24 percent of the bioregion habitat, 3.1 percent of MMCZ4, and about 0.6 percent of the habitat in the 3-state range.

These assumptions are probably reasonable insofar as they estimate the amount of occupied habitat and the effects on that habitat. However, they probably result in substantially overstating the actual effects on murrelets, because they include no adjustment for the likely difference in habitat quality between old-growth and residual, no adjustment for difference in habitat quality among old-growth stands of very different sizes, and may underestimate the amount of occupied habitat protected in HRSP. As stated earlier, there are no available data to apply to these questions, but there are obvious physical differences that suggest that considerable disparity exists between residual and uncut old growth. Because of the disproportionately high number of residual acres, the effect of this disparity on calculations is large. For instance, if an arbitrary value of 0.25 were assigned to residual acres (that is, if each acre of occupied residual stands were regarded as 25 percent as valuable to murrelets as each old growth acre), the “valued acres” on the ownership would be about 6,951, and in the bioregion, about 11,231. The proposed harvest of 1,803 “valued acres” under the Draft HCP would remove about 16 percent of those acres in the bioregion, about 1.5 percent of the habitat in MMCZ 4, and about 0.3 percent of the habitat in the 3 state range. This effect would be even lower if small stands of old-growth were rated as less valuable than large stands, or if more occupied habitat is found in the parks.

In summary, various methods of estimating effects on habitat, including those discussed above and those detailed in Appendix N, Part 2, Table 5A-5J, lead the agencies to a conservative reasonable estimate that the harvest contemplated under Alternative 2/2a might be expected to remove about 20 percent of the habitat value in the southern Humboldt bioregion. Due to the assumptions involved, this estimate is subject to uncertainty, but the most obvious variables have been accounted for in a reasoned analysis.

Another perspective was presented by Ralph et al. (1997 and 1998) (Vol. IV, Part B, sec. 9 and 10 in PALCO 1998), who analyzed comparative rates of observation of murrelet behaviors at all locations surveyed from 1992 through 1997 on PALCO lands and the parks. Initially, these efforts were applied to all detections of murrelets, but based on comments from the agencies and the HCP Scientific Panel, the method was refined to analyze only occupied behaviors, which are believed to be more indicative of nesting. (See notes of Scientific panel meeting of Nov. 10, 1997; Vol. IV, Part B, Sec. 7 in PALCO 1998.) They found low rates of detection of occupied behaviors at survey stations in small uncut old-growth stands and in residual stands not associated with old-growth, and concluded that 96 percent of the computed "Relative Bird Value (RBV)" in the southern Humboldt bioregion is contained in the parks, the Headwaters Reserve, and the MMCAs. According to their results, over 95 percent of the current RBV in the bioregion would remain if Owl Creek and the other old-growth and residual stands were harvested as proposed in the PALCO Draft HCP, and over 92 percent would remain if the Grizzly Creek complex were harvested instead of Owl Creek. These results of these projections are quite similar to the "best case" estimate described above.

Subsequent analysis by White (1997) (Vol. IV, Part B., Sec. 11 in PALCO 1998) at least partially supported the RBV methodology, and the HCP Scientific Panel suggested that this form of analysis could have been more fully utilized in evaluating relative worth of habitat patches. (See notes of Scientific Panel meetings for May 26-27, 1998, and notes dated May 29, 1998, in Vol. IV, Part B, Sec. 7, in PALCO 1998.) However, the results using occupied behaviors were not available until late during the development of the Draft HCP, which instead adopted a conservative approach that would preserve most of what were believed to be the high quality stands. The results of Ralph et al. (1998) provide additional corroboration to the view that the large old growth stands that would be preserved are of high value, and the small uncut old growth stands and scattered residual stands proposed for harvest are of relatively low value to marbled murrelets.

Assembly Bill 1986

Implementation of Assembly Bill 1986 (AB 1986) could change the levels of harvest and marbled murrelet protection in several ways, but the effects are uncertain at this time. The possible effects are discussed below, in order of the degree of certainty that the effect would occur.

First, as a condition of the purchase of the Headwaters Reserve, AB 1986 requires a modification to the HCP's aquatic conservation strategy. Where these zones exist within murrelet habitat that would have been harvested under the Draft HCP, slightly more murrelet habitat may be protected as a result of the wider no-harvest zones required by the legislation. This is not expected to result in a substantial improvement for murrelets, because even under full protection, riparian zones are probably not wide enough to avoid edge effects in most of the zone.

Second, AB 1986 provides that, as a condition of the purchase of the Headwaters Reserve, the Owl Creek MMCA would not be harvested during the term of the permit, and arranges a possible

acquisition process that would bring the Owl Creek area into State ownership. Thus, presuming that PALCO accepts this arrangement, any effect described above as resulting from the possible harvest of stands in the Owl Creek MMCA would not occur. The 317 acres of uncut old-growth, 239 acres of residual, and 350 acres of second growth that comprise the Owl Creek MMCA would be protected at least for the permit period and possibly in perpetuity.

Third, AB 1986 provides that the Grizzly MMCA will not be harvested for 5 years, and provides funding toward the public acquisition of this area. If after 5 years the acquisition of the Grizzly Creek MMCA has not been secured, PALCO could harvest the area pursuant to the HCP. Thus it remains possible that, 5 years after the issuance of the incidental take permit, effects of the harvest of Grizzly Creek described above could still occur. This would result in harvest of about 117 acres of uncut old-growth, 530 acres of residual, and 410 acres of second-growth that comprise the Grizzly Creek MMCA. If purchased by the State, this area would likely be added to the 969 acres of mixed habitats in GCSP.

If AB 1986 results in protection of both Owl Creek and Grizzly Creek, the total amount of uncut old-growth harvested under the HCP would be about 501 acres, less than 10 percent of the existing uncut old growth on the PALCO ownership. All of the uncut old growth that would be harvested is in stands of fewer than 90 acres, and 70 percent is in stands of fewer than 60 acres. The amount of residual that would be harvested would be about 8,321 acres. The total amount of PALCO's current old-growth that would come under protection would be 4,638 acres; the total PALCO residual that would come under protection would be 3,831 acres; and 5,536 acres of second growth would also be protected. Of this total of 14,005 acres, 7,672 acres (55 percent) would be in public ownership; the remainder would be in reserve status under PALCO ownership for the 50 year term of the permit.

Possible Effects of Habitat Removal on Marbled Murrelets

The effects of habitat removal depend on numerous factors. Except for information on description of stands, no data are available to support quantitative estimation of such effects. However, a qualitative assessment of the likely magnitude of effects can be made. Factors considered here include quality of habitat for supporting successful reproduction, the likelihood of direct killing of individuals, and the likelihood that displaced breeders will subsequently move to remaining habitat and breed successfully.

As stated earlier, evaluation of known physical factors in residual stands (low number of trees and nest platforms, low canopy closure, and lack of surrounding cover) strongly suggests that successful reproduction in residual stands is likely to occur at a lower rate than in old-growth stands. Reproduction in small uncut old-growth stands with high ratios of edge to interior is also likely to be lower than in large stands of uncut old-growth. This potential difference is incorporated in one of the above assessments and in one of the assessments in the TRA analysis (Appendix N, Part 2, Table 5A-5J) by assigning subjective values for habitat quality.

Some biologists have suggested that low quality habitat could constitute a "sink" where populations consistently fail to replace themselves (See HCP Scientific Panel notes for June 12

and 13, 1998; Vol. IV, Part B, Section 7, in PALCO 1998). Under this scenario, it might be better to remove the “sink” habitat and force breeders to increase their density in higher quality habitat. Lacking any data to support such a concept, the agencies have instead evaluated negative aspects of habitat removal, without assigning any positive value to removal of lower quality habitat. Should such speculative factors actually be affecting existing populations, the effects of the habitat removal would be less than estimated here.

Habitat removal would not result in direct killing of individuals unless harvest is carried out during the breeding season. Harvest during the breeding season would probably result in mortality of eggs and flightless young, but adults would probably escape. The Draft HCP proposes to harvest occupied marbled murrelet habitat during the breeding season (partially necessitated by increased restrictions on winter operations for protection of salmonids). The Draft HCP states that if nests are found in stands available for harvest, they would be protected until after the breeding season, but the agencies believe that lack of pre-project surveys and the difficulty of finding nests renders this proposed mitigation practically meaningless. The possibility of killing eggs and chicks would be somewhat reduced by the partial seasonal protection that would be applied under the Draft HCP during the harvest of either Owl Creek or Grizzly Creek. However, as proposed by the Draft HCP, this protection does not apply to other occupied stands that would be available for harvest, so some direct mortality would probably result. AB 1986 contains no specific provisions in this regard. The legislation does mandate that in order for the funds to be available, the final HCP must be no less protective of aquatic or avian species than the Draft HCP. It is currently uncertain how take minimization in the form of seasonal protections might be applied under this mandate.

Harvest of uncut old-growth and residual stands will probably result in permanent loss of at least small numbers of sites used for nesting, which would require adults to nest elsewhere or abandon nesting behavior. If adults displaced from breeding areas by timber harvest are able to find other habitat where they can breed successfully in subsequent years, the effect of harvest of habitat would be reduced. No data are available to apply to this question, and the outcome of such a scenario is completely speculative. Based on behavior of related species of seabirds, some authors have suggested that marbled murrelets may have limited ability to change their breeding locations (Divoky and Horton 1995). However, assuming that sufficient marine prey is available to bring adults into breeding condition, it seems likely that at least some displaced adults would attempt to nest in remaining habitat.

It is theoretically possible that remaining habitat is already occupied to its optimum density, and that “packing” by displaced breeders into already occupied habitat would not lead to a commensurate increase in reproductive output from the remaining stand. In the worst case, none of the displaced breeders would ever breed successfully again, but would continue to compete with the rest of the population for prey until their eventual senescence and death. In a more likely scenario, some portion of the displaced birds might become reproductively-capable “floaters” waiting for an open breeding location, in which case their availability might partially offset the population effects of natural mortality among other breeding adults. Although these scenarios are interesting to consider, no supportable conclusion can be reached beyond the

statement that there will be a reduction in habitat that is apparently used for breeding, and as a result, reproductive output would be expected to decline to some unknown degree.

During development of the Draft HCP, PALCO sponsored an attempt to statistically model the effects of habitat loss on murrelet populations in MMCZ 4 (Ackakaya 1997; see Vol. IV, Part B, Sec. 5 in PALCO 1998). This analysis used estimates of population parameters to model population trends, and then examined the effects on those trends that might result from reductions in population parameters due to habitat loss. The estimates of habitat loss included several levels of timber harvest in the southern Humboldt bioregion. To summarize the outcome, potential risks of population decline related to habitat removal were extremely variable. Under the most pessimistic estimates of existing population performance, the loss of reproductive habitat had little bearing on population trend, because the population was rapidly declining at levels below the carrying capacity of breeding habitat, and thus, habitat removal had little effect on the population trend. Under more optimistic estimates of existing population performance, effects of habitat removal were more easily detected, but the overall risk of catastrophic decline was lower. No critical threshold could be identified, because the high degree of uncertainty regarding actual population parameters necessitated a range of estimates that introduced extreme variability into the results.

In a recently-published article on population viability analysis, Beissinger and Westphal (1998) urged abundant caution in application of models constructed with inadequate data on demographic parameters. These authors mentioned the PALCO / Ackakaya modeling effort as a specific example of cases in which "Sometimes so little is known about demography, and the range of vital estimates is so large, that model outcomes will vary from complete extinction to no extinction for the same management regimes, depending on the mean rates chosen." They characterized such efforts as a waste of resources. Similarly, the HCP Scientific Panel stated that the Ackakaya effort should not be used as a major guiding component because of its ambiguities (See notes from Panel meeting of May 29, 1998, Vol IV, Part B, Sec. 7, PALCO 1998).

The agencies believe that the Ackakaya effort represented a good faith effort by PALCO and others to evaluate the possible impacts of the proposed harvest. Unfortunately, the effort's primary finding was that existing data for the marbled murrelet are inadequate for meaningful modeling of population response to potential changes in population parameters. It appears that it will be many years until sufficient data are produced, so other tools for evaluation must be employed. Basically, this modeling attempt demonstrated that evaluation of the effects of the proposal must depend almost entirely on application of basic principles of conservation biology and careful judgment rather than statistical analysis and population modeling.

Benefits of the Marbled Murrelet Conservation Strategy

The previous section described the aspects of the proposed project that would be negative for marbled murrelets. The following section will discuss aspects of the proposed project that would have positive conservation benefits for the murrelet. Most of the following data on stand acreage can be viewed in tabular form in Appendix N, Part 2.

The primary benefit to the murrelet associated with the proposed project is the public acquisition of the Headwaters Forest. Containing over 3,100 acres of contiguous high quality old-growth and 665 acres of residual within 12 miles of the Pacific Ocean, the Headwaters area is arguably the most important parcel of habitat in private ownership in the 3-state range of the marbled murrelet. As a result of this acquisition, the two most important murrelet habitats in the southern Humboldt bioregion, Headwaters and HRSP's Bull Creek, would be under permanent protection. Under AB 1986, both the Owl Creek MMCA and the Grizzly Creek MMCA may also be acquired.

Another very important benefit of Alternative 2's conservation strategy is the establishment of the MMCAs. Eight such areas are delineated in the Draft HCP, seven of which would be established for the 50-year life of the permit. As proposed by the Draft HCP, the seven protected MMCAs could only be harvested during this period if marbled murrelet populations recover to the extent that the protections afforded the species under the Act were no longer necessary and the species qualified for removal from the list of threatened and endangered species. AB 1986 would extend complete protection for the permit period.

Under the PALCO Draft HCP, one of the eight delineated MMCAs (either Owl Creek or Grizzly Creek) could be chosen for harvest at the option of the company. The seven remaining areas would include at least 60 percent of the remaining uncut old-growth murrelet habitat on the ownership outside of the Headwaters. This reserved acreage would include most of the largest remaining old-growth redwood groves on the property (393 acres in the Allen Creek MMCA, 339 acres in the Bell Lawrence MMCA, 255 acres in the Shaw-Gift MMCA, and either 317 acres if Owl Creek is preserved or 117 acres if Grizzly is preserved -- or both of the latter two if AB 1986 is fully implemented.) These old-growth stands would be aggregated with residual stands (totaling 2,927 acres of residual if only the Grizzly area is preserved; 2,636 acres if only the Owl Creek area is preserved; or 3,166 acres if both areas are preserved under complete implementation of AB 1986) along with about 3,200 acres of second-growth stands to produce a substantial system of reserves expanded upon the best habitat existing on the property today. With slight variation depending on the harvest option, the residual preserved in MMCAs would include about 50 percent of the known occupied residual acreage outside the Headwaters Reserve. Under complete implementation of AB 1986, 57 percent of the known occupied residual outside the Headwaters Reserve would be protected in MMCAS.

During the 50-year life of the permit, the residual stands within the MMCAs would be expected to provide an increase in the amount of good quality habitat adjacent to the uncut old-growth stands. For example, if the Owl Creek option were harvested, 1,327 acres of second growth within the MMCA residual stands could reasonably be expected to exceed 120 feet in height

within the 50-year permit period. In the remaining 1,840 acres of MMCA residual stands, the second-growth that is young forest today should exceed 100 feet in height within the permit period, approaching the size at which it will provide cover for crowns of residual trees, and providing management options for the managers of that day. Also within the MMCAs, bordering the uncut and residual stands, about 3,200 acres of second-growth will provide a dense buffer against climatic effects and possibly against the intrusion of predators. If Owl Creek were protected and Grizzly Creek harvested, less residual would be protected (but more uncut old-growth protected, as explained in the previous paragraph.) Because residual stands in the Owl Creek area have younger second growth than Grizzly, the amount of habitat improvement would be slightly less if Grizzly were harvested. For the same reason, there would be little change in the total improvement of residual within the permit period if AB 1986 is fully implemented.

Thus, the general effect of the Draft HCP in the short term would be to allow harvest of lower quality old-growth and residual in scattered stands while protecting most of the high quality habitat. The effect in the long term would be an improvement in high quality habitat concentrated around the best existing uncut old-growth stands. Under the Draft HCP, total habitat would decline in the first few decades as the Owl Creek or Grizzly old-growth, the scattered smaller stands of old-growth, and eight to nine thousand acres of mostly low density residual are harvested. Under AB 1986, this decline could be less than contemplated under the draft HCP, if both Owl Creek and Grizzly are protected.

In any case, approximately 20 years after issuance of the incidental take permit, murrelet habitat on the property would be at its lowest expected amount, mostly confined to the uncut old-growth and residual stands in the MMCAs. At that time, habitat in the southern Humboldt bioregion would include about 8,500 to 8,800 acres of high quality uncut old growth in large stands. About 50 percent of the uncut old-growth habitat in the bioregion would be in parks (assuming that park habitat does not increase), about 35 percent in the Headwaters Reserve, and about 15 percent in MMCAs. Also, about 2,600 acres to 3,000 acres of residual stands would be concentrated in MMCAs, in addition to 665 acres of residual in the Headwaters Reserve and about 3,354 acres of residual in the parks. Additionally, about 3,200 acres of second growth, ranging from 60 feet to over 120 feet in height, would exist within the MMCAs, and about 3,696 acres of second growth ranging from 60 feet to over 120 feet in height would exist in the Headwaters Reserve (1,927 acres if the Elk River Timber lands are not acquired).

By the end of the 50 year permit period, the improving condition of second-growth beneath residual stands would increase the acreage of large blocks of nesting habitat in the MMCAs to a level that exceeds the amount of high quality habitat on the ownership outside the Headwaters today, and the option would exist to allow habitat to improve even further in future decades. The major difference at that time would be that today's stands of low density residual timber scattered across the landscape would be absent, and old-growth and residual habitat in the MMCAs would be much less fragmented, forming larger contiguous stands that include today's most important murrelet habitat. Also, extensive areas currently in young second growth would form dense protective buffers ranging from 60 to over 120 feet in height around and amid the old growth and residual stands. The expected result would be a substantial improvement in the amount of high

quality murrelet breeding habitat, and a corresponding improvement in the reproductive output of marbled murrelets in the southern Humboldt bioregion.

The HCP planning process necessarily involves evaluating habitat quality and risk associated with habitat loss within a context of maintaining economic opportunity for the applicant. This Draft HCP represents a substantial effort by PALCO and the agencies to arrive at a solution that incorporated each of those factors. Lacking strong data on the relationship between habitat characteristics and marbled murrelet reproductive success, the planning effort for the PALCO Draft HCP relied on basic conservation principles, directing harvest to lower quality habitat, preserving high quality habitat in large blocks, and providing capacity for habitat improvement. The proposed action is consistent with those principles.

Consistency With The Marbled Murrelet Recovery Plan

The Marbled Murrelet Recovery Plan (USFWS 1997) contains the following relevant passages regarding the needs of the species, the PALCO ownership, and HCPs:

1. Regarding MMCZ 4:

This zone has large blocks of suitable habitat critical to the three-state marbled murrelet population recovery over the next 100 years. However, the amount of suitable habitat protected in parks is probably not sufficient by itself to guarantee long-term survival of marbled murrelets in this Zone. On the other hand, a considerable amount of habitat is preserved in parks such that survival may be more likely in this Zone than in several other Zones. Private lands at the southern end of this Zone are important for maintaining the current distribution of the species. (From p. 128)

2. Regarding the importance of PALCO lands:

Essential nesting habitats that occur on forest lands under non-Federal management include: ...Suitable nesting habitat on Pacific Lumber Company lands in Humboldt County, California. These areas are a significant portion of the currently available nesting habitat for the southern part of Zone 4. This area has known nest sites and is situated in a key area, close to the coast, with no federal lands in the immediate area that are able to provide similar recovery contributions. Maintenance of suitable habitat in this area is also critical to avoid widening the gap between the central California population and the southern end of Humboldt County. (From pp. 132-133)

3. Regarding private lands and HCPs:

Maintenance of marbled murrelet populations on private lands is critical in arresting the decline of the species in the next 50-100 years. This is especially true where additional nesting habitat is not expected to be available on nearby Federal lands. While the Endangered Species Act section 9 prohibition against unauthorized incidental take provides some protection for the marbled murrelet, this may not be sufficient to protect

and enhance habitat on non-Federal lands in the long term. This is because a continuing decline in populations would be expected to eventually result in unoccupied habitat where the prohibition against take may not apply. This unoccupied, but suitable, habitat may then be harvested, continuing the erosion of habitat that is needed to recover the species. Habitat Conservation Plans with appropriate measures to minimize and mitigate incidental take in the short term while providing for maintenance or creation of habitat in the long term probably offer the best means for conservation of the species on non-Federal lands. Land acquisitions or exchanges by Federal or State agencies and conservation organizations could also contribute to protection and enhancement of habitat. (From pp. 133-134)

Protected areas on Federal lands are expected to eventually provide sufficient habitat to possibly maintain viable populations of marbled murrelets over the long term (50-100 years and beyond) for most Zones in the three-state area. However, the demographic bottleneck that the marbled murrelet population may experience during the next 50-100 years makes the maintenance of marbled murrelet populations not found within Federal lands (mainly on state and private lands) an important component of more guaranteed viability and eventual recovery over the coming decades and into the future. Specific management plans should be developed (e.g., Habitat Conservation Plans, SYPs, etc.) for occupied and other potential marbled murrelet nesting habitat on non-Federal lands. These strategies should incorporate the best biological information about the recovery needs of the marbled murrelet and actually contribute to the conservation of the marbled murrelet. (From pp. 137-138)

4. Regarding maintenance of occupied nesting habitat:

On non-Federal lands the maintenance of all occupied sites also should be the goal. However, it is realized that through the Habitat Conservation Plan process, there may be some limited loss of occupied sites or unsurveyed suitable habitat. In the short term (the next 5-10 years), until additional information is obtained, loss of any occupied sites or unsurveyed suitable habitat should be avoided or the potential impacts significantly reduced through a habitat evaluation process outlined in the Habitat Conservation Plan. Short-term trade-offs for long-term benefits should be evaluated very carefully at this early stage of marbled murrelet recovery and should be done on a case-by-case basis. (From pp. 138-139)

5. Regarding the importance of maintaining habitat in large blocks:

By maintaining occupied sites and suitable habitat in larger blocks with lower levels of fragmentation, several objectives will be met. Larger stands will 1) have more nesting and hiding opportunities, 2) provide for multiple nesting sites for individual pairs of birds over time, 3) facilitate nesting for multiple pairs of birds (and thus promote increased social contact), and 4) provide greater interior forest habitat conditions (to reduce potential nest and adult predation, increase protection of nests from windstorms and environmental changes, and reduce loss of habitat from windthrow and fire.) Larger

stands may also provide a core of birds to attract or develop sufficient activity and eventual nesting by subadults or nonbreeding adult birds to replace breeding adults lost from this habitat over time due to natural causes or human activities. (From p. 139)

6. Regarding maintenance of and enhancement of buffer habitat surrounding occupied habitat:

Maintaining buffers around occupied habitat will mediate the effects of edge by helping to reduce environmental changes within the stand, reduce loss of habitat from windthrow and fire, reduce fragmentation levels, increase the amount of interior forest habitat available, and potentially help reduce predation at the nest. To have the greatest benefits, buffers should be a minimum of 300-600 feet and should consist of whatever age stand is present, including existing plantations (which should be managed to provide replacement habitat.) (From p.140)

The agencies believe that the proposed action, which includes acquisition of the Headwaters Reserve and implementation of the PALCO Draft HCP, is consistent with recommendations in the Recovery Plan. On PALCO lands, a key area identified by the Recovery Plan, the Federal and State governments are acquiring the largest, most important habitat, the Headwaters Forest. The proposed HCP would protect most of the remaining high-quality habitat on the ownership. While some occupied habitat would be harvested, the harvest would be confined to the smaller, most fragmented stands of uncut old growth and to scattered residual stands whose physical characteristics suggest they are lower quality habitat, and where rates of detection of occupied behaviors are low. The degree of short-term impact would be relatively low because the harvest is confined to lower quality habitat.

The reserve design would create large blocks of habitat that are based around the best available habitat remaining on the property, and would provide for a substantial increase in habitat quality within the reserves. The reserve areas are buffered with second-growth wherever ownership patterns allow. The reserve design would also maintain the current distribution of the species in the MMCZ 4 and not exacerbate the gap between the Humboldt population and the central California population. The proposed action is consistent with recommendations of the Recovery Plan and should contribute to the long term viability of the marbled murrelet. If fully implemented, the measures prescribed by Assembly Bill 1986 (i.e., the purchase of the Owl Creek and Grizzly Creek MMCAS by the State of California) would further increase protection for the marbled murrelet under the HCP.

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Table N.1-1. Marbled Murrelet Habitat in Southern Humboldt County (acres)

	Uncut Old Growth Presumed Occupied *	Uncut Old Growth Low/No Survey	Total Uncut	Residual Presumed Occupied *	Residual Low/No Survey	Total Residual	Total Old Growth
PALCO Headwaters	2643	474	3117	610	55	665	3782
PALCO Not Headwaters	1587	436	2023	4907	6875	11,782	13,804
PALCO Subtotal	4230	910	5140	5517	6930	12,447	17,586
State Parks	4250	16,059	20,310	122	3232	3354	23,663
Total S Humboldt	8480	16,969	25,449	5867	9933	15,800	41,249

* Presumed occupied is contiguous habitat within ½ mile of occupied survey station

(Based on TRA Table 5A and 3B, Appendix N, Part 2)

Table N.1-2. Estimates of the Acreage of Potentially Occupied Marbled Murrelet Nesting Habitat at Various Landscape Scales Within the Species' Listed Range

Region/Unit	Acres
<i>Pacific Lumber Company Lands</i>^{1/}	
Headwaters/Elk Head Springs	3,117
Other High Quality ^{2/}	2,022
Low/Moderate Quality ^{3/}	7,250
TOTAL	12,389
<i>Southern Humboldt Bioregion (Bioregion)</i>	
Pacific Lumber	12,389
Humboldt Redwoods State Park ^{4/}	4,095
Grizzly State Park ^{5/}	388
TOTAL	16,872
<i>Marbled Murrelet Conservation Zone 4 (MMCZ4)</i>^{6/}	
Bioregion	16,872
Simpson	608
Stimson	91
Yurok	250
Six Rivers National Forest	3,719
Arcata BLM	568
Redwood National and State Parks	38,982
Oregon	64,727
TOTAL	125,817
<i>California</i>^{7/}	
MMCZ4(CA)	61,090
MMCZ5	430
MMCZ6	7,250
TOTAL	68,770
<i>3 State (Washington, Oregon and California)</i>^{8/}	
WA ^{9/}	373,875
OR ^{9/}	254,869
CA	68,770
TOTAL	697,514

- 1/ Habitat estimation method on Pacific Lumber Company lands: contiguous occupied old growth/residual habitat within 0.5-mile radius of occupied survey stations on Pacific Lumber Company lands (excluding Headwaters)
- 2/ High quality indicates unentered old growth redwood outside Headwaters; assumes remaining inadequately surveyed is 100% occupied
- 3/ Low/moderate quality indicates residual redwood and inland Douglas-fir; assumes remaining inadequately surveyed is 25% occupied
- 4/ Habitat estimation method in state park: contiguous occupied old growth/residual habitat within 0.5-mile radius of occupied survey stations
- 5/ Includes all uncut old-growth within the state park
- 6/ Habitat estimation method in MMCZ4: Bioregion total plus estimates made for lands listed; estimates based on draft HCPs and personal communications with local biologists (OR total explained below)
- 7/ Habitat estimation method in California: MMCZ4 minus Oregon habitat plus totals for MMCZ5 and MMCZ6. MMCZ5 and MMCZ6 estimates based on L. Roberts (FWS), E. Burkett (CDFG), pers. comm.
- 8/ WA = 1.5 million potential suitable acres (T. Young, FWS-GIS, pers. comm.) x 0.25 occupancy index (WDNR HCP, Hamer, pers. comm.) excluding 1,125 acres for Quinalt
- OR = 2 conservation zones, MMCZ3 and MMCZ4 (Total = 254, 869 likely occupied acres)
- MMCZ4 = (1) 20,000 acres, Siskiyou National Forest, Rogue National Forest, and Medford BLM (USFS GIS, 80,000 acres x 0.25 occupancy index; index derived from Dillingham et al. (1995), Meyers 1995, ODFW marbled murrelet survey database, and S. Livingston, pers. comm.)
- (2) 44,727 acres in Coos Bay BLM (J. Heaney, BLM, pers. comm.)
- MMCZ3 = (1) 137,500 acres, Suislaw National Forest (C. Froupfelker, USFS, pers. comm.)
- (2) 5,567 acres, Eugene BLM (D. Huber, BLM, pers. comm.)
- (3) 30,075 acres, Coos Bay BLM (J. Heaney, BLM, pers. comm.)
- (4) 4,000 acres, northwest Oregon (N. Bentivoglio, FWS, pers. comm.)
- (5) 13,000 acres, Elliott State Forest HCP
- (6) Private lands unknown but likely very small amount
- 9/ Habitat in Oregon and Washington generally lower quality than California redwood forests, with lower murrelet densities

Table N.1-3. Effects on Residual Under Alternative 2

Canopy Closure % Ht. of 2 nd Growth (ft.)	50-75% <60	50-75% >100	25-50% <60	25-50% >100	25-50% 60-100	0-25% <60	0-25% >100	0-25% 60-100	Totals
Protect ¹									
MMCA - Not CH ²	48	39	179	--	46	132	--	486	930
MMCA - CH	213	--	654	--	196	614	--	560	2237
MMCA - Subtotal	261	39	833	--	242	746	--	1046	3167
Harvest ³									
No Restrict-Not CH	63	194	1109	425	277	2373	37	2078	6555
1320			21		8	43	32	101	205
300			8		2	9	7	59	85
No Restrict-CH	81	--	796	--	41	666	--	182	1767
300									0
Subtotal	144	194	1934	425	328	3091	76	2420	8612
Total	405	233	2767	425	570	3837	76	3466	11779

¹ Does not include 665 acres of residual in Headwaters reserve

² Designated Critical Habitat

³ Assumes harvest of Owl Creek Option

Table N.1-4. Harvest of Marbled Murrelet Habitat Under Alternative 2 (acres)

	Uncut Old Growth Presumed Occupied*	Uncut Old Growth Low/No Survey	Total Uncut	Residual Presumed Occupied*	Residual Low/ No Survey	Total Residual	Total Old Growth
Option: Cut Grizzly	213	406	619	2485	6661	9146	9765
Option: Cut Owl	449	369	818	2306	6549	8856	9674
AB 1986: Cut Neither	150	351	501	2083	6533	8616	9117

*Presumed occupied is contiguous habitat within one-half mile of occupied survey station
(Based on TRA Table 5 A, Appendix N, Part 2)

APPENDIX N

PART 2

MEMORANDUM REGARDING THE FOLLOWING:

- **Pacific Lumber HCP/SYP**
- **Background Information on HPC for Marbled Murrelet**
- **Revision to Memorandum of June 5, 1998**

MEMORANDUM

TO: Steve Beissinger fax: 510-643-5098
Harry Carter 707-678-5039
Tom Hamer 360-422-6510
Gary Miller 503-231-6195

FROM: Tom Reid

SUBJECT: Pacific Lumber HCP/SYP
: Background Information on HCP for Marbled Murrelet
Revision to memo of June 5, 1998

DATE: September 22, 1998

TRA FILE: CPAL

This is a revised version of the memo sent June 5, 1998 and discussed in the subsequent June 8 meeting. The revision provides new information, discusses additional tables and figures corrects unclear language, and transmits changes in tables showing old growth redwood in buffers around old growth redwood on public land as available for harvest under the July 1998 HCP. Old growth redwood in buffers is only residual and totals 295 acres, thus the change in the tables is small.

* * * * *

Under the direction of Jim Gaither at the California Resources Agency, I have been working with technical staff of the state and federal wildlife agencies to synthesize the work on marbled murrelet for Palco's HCP. I am transmitting a summary for discussion.

Introduction

Pacific Lumber (Palco or PL) seeks an incidental take permit for the marbled murrelet and other species based on a proposed HCP. The Headwaters purchase is a corollary of the HCP.

The federally listed range of the marbled murrelet extends from Washington State into central California. The Marbled Murrelet Recovery Plan (1997) delineates six Marbled Murrelet Conservation Zones (MMCZ) based on population distribution. The PL ownership is in the "Southern Humboldt Bioregion" portion of MMCZ4. **(See Figure #1, Marbled Murrelet Conservation Zones and Southern Humboldt Bioregion.)** A portion of the range of the Marbled murrelet has been designated as critical habitat. A 36,973 acre portion of PL's ownership, including Headwaters, is in designated critical habitat. **(See Figure #2, Marbled Murrelet Critical Habitat.)** Humboldt Redwood State Park to the south and Grizzly Creek State Park along the Van Duzen River are also in critical habitat.



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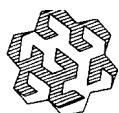
The HCP planning area is a total of 219,298 acres, which includes 209,830 acres of PL land and 9,468 acres of Elk River Timber Company (ERTC) land subject to the Headwaters purchase and land exchange. With the Headwater purchase, 7,478 acres of the planning area would be under public ownership and 211,820 acres would be in PL ownership.

PL's July 1998 HCP proposes establishment of a series of Murrelet Conservation Areas (MCAs) for the life of the permit, and take minimization restrictions on operations elsewhere on PL land. Buffer areas are provided for PL land adjacent to OGR on public land. **Figure #3A, Study Area** and **Figure #3B, Study Area, Enlargement** show the proposed MCAs and their names and the 1/4 mile and 300-foot buffer areas (note that the legend for the A-B figure pairs is on figure A). The July 1998 Draft HCP provides for protection of all MCAs for the 50-year life of the permits, with an option to harvest either the Owl Creek or the Grizzley Creek MCA. Areas within 300 feet of OGR cannot be clear-cut and must maintain a minimum of 240 sq.ft of basal area after harvest. Areas within 1/4 mile are subject to seasonal harvest restriction to avoid murrelet nesting, but may otherwise be clear-cut when harvested.

On August 31, 1998, the California legislature approved inclusion of state funds for Headwaters purchase under Assembly Bill 1986. AB 1986 restricts the use of state funds for Headwaters purchase such that the Owl Creek MCA would be protected for the life of the permit and it provides additional funds for potential state purchase of Owl Creek. AB 1986 requires a 5-year delay in harvest of Grizzley Creek and also provides funds to initiate potential purchase of the Grizzley Creek Complex. Thus, AB 1986 essentially decides PL's "option" of Owl Creek v. Grizzley as "preserve Owl", and it delays and possibly obviates harvest of the Grizzley MCA.

PL's July Draft HCP/SYP application has not been modified in response to the provisions of AB 1986 and the July draft remains the proposed project subject to analysis in the EIS/EIR. The funding restrictions of AB 1986 and the supplemental appropriation for further public purchases will probably be incorporated in the final HCP/SYP. In most of the tables in this memo, totals of preservation or totals of area available for harvest are given for each of the two PL options, and for the possible effect of AB 1986, where neither is harvested.

With the Headwaters purchase and the delineation of the MCA's, most (4,322 acres, 84%) of the uncut (unentered, or virgin) old growth redwood (OGR) on PL's property is set aside from harvest. A substantial amount (at least 3,300 acres, 27%), of lower density residual old growth will not be available for harvest. The MCAs and Headwaters contain some 15,000 acres in total, including about 7,000 acres of second growth. The 300-foot selective harvest buffer includes some 421 acres, with 90 acres of OGR residual. The basal area limitation in the 300-foot buffer may practically prevent harvest of some of the residual present, but because the HCP does not specifically prohibit OGR harvest in the buffers, the revised analysis assumes that it would all be available for harvest.



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The general strategy for the MCAs is to focus conservation on the larger uncut stands or relatively contiguous uncut-residual old growth stands. Stands are buffered and incorporate second growth to improve geometry and increase connectivity - both for biological and management reasons. With Headwaters, the MCAs would protect most (86% with option to cut Owl Creek) of the uncut and residual in critical habitat and add the PL Grizzley Creek complex lands adjacent to the State Park which are now outside of critical habitat to build on the existing old growth in the state and county park and extend protection along the Van Duzen River corridor.

Habitat

Most of the uncut and some of the residual OGR is occupied or potentially occupied by marbled murrelet and hence harvest would amount to a take of murrelet. The usual means to estimate take in an HCP is by estimating the area of habitat lost. The HCP would allow PL to plan for harvest of roughly two-thirds of the residual OGR on its property. Because the lower density residual is generally believed to be lower quality habitat, it should have a lower probability of occupancy and its harvest should result in a disproportionately lower estimate of take. Further analysis of the effects on residual will be presented in the Draft EIS/EIR.

SPI land involved in the Headwaters purchase does not contain appreciable amounts of OGR timber and no OGR is mapped there. Other OGR timber is found on the ownership outside of the area specifically designated as an OGR forest type, but these trees are scattered so rarely that they do not constitute potential habitat for the marbled murrelet and are not mapped as OGR forest type. **Table #1, Summary of Old Growth Redwood and HCP Status**, shows a summary of OGR forest cover broken down by status under the proposed HCP. Several timber classes are aggregated to show three classes of uncut OGR and two classes of residual OGR. **Figure #4A, Uncut and Residual Old Growth Redwood** and **Figure #4B, Uncut and Residual Old Growth Redwood, Enlargement** shows the distribution of OGR forest cover. **Figure #5A,B Old Growth and Second Growth Forest** shows the MCA and the OGR forest cover in the context of second growth on PL's ownership. Much of the OGR uncut groves are in the central area where harvest over the past two decades leaves the OGR embedded in very young second growth.

In Table 1 .A, page 2, the several HCP options are tallied. Depending on whether Owl Creek, Grizzley Complex, or neither is harvested, all HCP conservation and the Headwaters Forest purchase will protect some 4,321 ac (84%) to 4,638 ac (90%) of uncut, unentered OGR and make available from 501 (10%) to 818 ac (14%) for harvest. Some of that "available" area may be subject to restrictions from the no-cut./selection-cut aquatic buffer. Much more residual is available for harvest.

The majority (96%) of the residual is the low density (under 15 trees per acre). Further classification by timber volume shown in **Figure #6, Old Growth Redwood Timber Volume by Type**, where the various mapping polygons are ordered by the density of redwood timber volume estimated to be present. Timber volume does not



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directly correspond to habitat, but is a further distinction in OGR density. **Table #1 B, Distribution of Old Growth Redwood by Timber Volume by HCP Status** shows the approximate classification of HCP action by timber volume. It shows that the only 4.1% of the OGR residual set aside under HCP MCAs have OGR timber density less than 25 thousand board feet per acre (MBF/ac) whereas 37.7% of the residual available for harvest is in the lower density class. This implies a qualitative distinction: the residual OGR available for harvest has less timber volume because it has fewer trees or smaller trees.

Assessment of canopy shows that two-thirds of the low density residual is less than 25% canopy, with no significant difference between MCAs and the area available for harvest.

Table #1C, Old Growth Forest Types and HCP Status In- and Outside of Critical Habitat summarizes the distribution of OGR and other forest types in and outside of the designated critical habitat. It shows that the HCP overall would make 9,430 acres of all OGR available for harvest (with the option to cut Owl Creek)

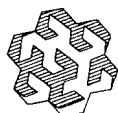
Marbled Murrelet Survey Data

The PL ownership has been surveyed for murrelet occupancy for 1992 through 1997. Survey data is collected from March through August, hence results for 1998 will not be available until fall. The survey on PL land has been conducted primarily for the purpose of determining whether a specific stand of old growth could be cleared for harvest. The survey was not conducted uniformly or with a design intended to determine the distribution or density of murrelet on the entire property. Survey in nearby Humboldt Redwood State Park (HRSP) has been more uniform in design, but less intense and covers only 1997. **Figure #7A, B Marbled Murrelet Survey Status** show murrelet survey stations and survey status.

The survey stations are reported as “occupied”, “present”, or “not detected”. “Present” indicates that birds were observed, but that reproductive behavior was not observed. See discussion by others.

A OGR stand is deemed “occupied” if any survey station in the stand is observed “occupied” one or more times. The occupied station may lie as far as 200 meters (640 feet) from the edge of the OGR due to the need to place stations in areas suitable for observation. The stand is defined as any contiguous OGR, either uncut or residual, with no more than a 100 m gap of unsuitable habitat in the forest cover. Low density residual or OGR trees lacking proper nest site characteristics may be considered unsuitable. Thus, a forest type map alone cannot specifically show contiguity - that can only be determined in the field.

For the purpose of approving a stand for harvest, an OGR stand is deemed “not occupied” if it is not contiguous with an occupied station and if there are sufficient negative survey results. A negative survey means either four or more survey days with



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no murrelet detections or ten or more survey days with only presence detection. There should be a survey station for every 30 acres of suitable OGR forest in the stand. The determination of habitat suitability and the need for survey reflects qualitative judgement in the field.

The habitat take estimate is based on an estimate of the probable area of PL ownership that is not occupied and hence where harvest would not be a take -- it is not intended to specifically approve any stand for harvest. **Figure #8A,B Marbled Murrelet Survey Status Within 1/2 mile of Survey Stations** gives an indication of murrelet presence overall by drawing a 1/2 mile radius circle out from each survey station. The overlapping circles are in precedence order occupied > present > not detected.

Survey stations are subject to non-uniform effort. As illustrated in **Table #2, Murrelet Survey Counts at Stations, by Result**, most of the "presence" and "not detected" stations are not surveyed to a sufficient intensity to conclude that the stand is not occupied. The protocol allows fewer surveys where several stations are close (overlapping 200m circles). The analysis in Table #2 does not reflect the spatial clustering of stations so some with low survey intensity could have been determined to be non-occupied. Inspection of the map shows that few such clusters still have OGR present.

The uncut and residual old growth redwood can be related to the 1/2 mile survey circles. **Table #3A, Old Growth and Marbled Murrelet Survey Status** is an extensive cross-tabulation of the forest types presented earlier and the survey status in the circles. Data are presented for PL ownership and for Elk River Timber Company (ERTC) land involved in the Headwaters purchase and land exchange. **Table #3B, Forest Type and Marbled Murrelet Survey Status in State Parks** presents similar data for the more than 50,000 acres of adjoining state park land in Humboldt Redwoods and Grizzly Creek Redwoods Parks. The forest typing is different from the categories used on PL land, but the aggregation is comparable.

GIS can calculate contiguity using the rules cited above, but it cannot make the field judgements of continuous habitat in the many areas that are low density residual OGR. Thus, the GIS will consider larger areas as contiguous than may be determined in the field. With strict rule application and survey results through 1997, 11,580 acres of all OGR types are contiguous with an occupied station. **Table #4A, Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status** overlays the 1/2 mile survey station circles on the GIS analysis of strict contiguity for the various MCA; **Table #4B, Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status - HCP Summary** give a focused tally for the various conservation options and a percent breakdown.

The distribution of murrelet occupied detections gives an indication of the distribution on PL land, but is clearly non-uniform as to either sample location and sample intensity. In principle, stations with more occupied detections per unit of survey effort may have higher density of murrelet nesting. RSL developed a mean



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standardized occupancy detection, adjusting the number of detections according to a time-of-year detection factor and dividing by the number of standard surveys. The raw result has no direct biological value and we mapped mean detections ordering stations from high to low and grouped them by percentile. **Figure #9, Relative Frequency of Occupied Detection in Marbled Murrelet Surveys** shows stations which are in the highest 10% of all stations by large circles, and stations in lower percentile groups by smaller circle. Because mean occupancy is detections divided by number of surveys, stations with low survey effort tend to score high - or not at all, depending on the chance detection. This may explain why the Humboldt Redwood State Park has so many stations in the top 10%. Nonetheless, the frequency map suggests dense use in the Headwaters and in most of the lesser cathedrals.

Impact

The projected take of habitat from the HCP depends on assumptions of the extent of occupancy of thousands of acres of low density old growth residuals in the low/no survey areas. **Table #5A, Old Growth Redwood Timber Coverage and Occupancy** summarizes the analysis of the preceding tables and simplifies the allocation of OGR to either "presumed occupied" or "low/no survey". State park data are incorporated to yield a total for Southern Humboldt County. Conservation options are compared with this context.

This compilation leaves three binary variables: location of OGR (PL or State Park), OGR type (uncut or residual), and survey status (presumed occupied or low/no survey). Different assumptions about the likelihood of murrelet occupancy can be made for these different attributes. Two examples are illustrated here.

In **Table #5B, Probability That OGR Habitat is Occupied, based on Survey Status, OGR Type, and Location; Case: Uniform Assumptions**, probability of occupancy factors are tabulated: all "presumed occupied" is 100% likely to be occupied and all "low/no survey" is only 25% likely to be occupied -- regardless of whether the area is uncut or residual type and regardless of whether it is on PL or State Park land. When the probability factors are applied to the distribution of OGR in Table #5A, **Table #5C, Potential Marbled Murrelet Occupied Habitat; Case: Uniform Assumptions** results. The actual area acreages become "potential" habitat when multiplied by the probability factors .

In **Table #5D, Probability That OGR Habitat is Occupied, based on Survey Status, OGR Type, and Location; Case: PL Centered Assumptions**, a different set of assumptions is used. Whereas the previous example was uniform assumptions, these heavily weight PL land: on PL land, all uncut is 100% likely to be occupied, regardless of survey status, but on State Park land, only the presumed occupied is 100% likely and the low/no survey is considered 0% likely to be occupied. A similar skew applies to residual OGR. The results are given in **Table #5E, Potential Marbled Murrelet Occupied Habitat; Case: PL Centered Assumptions**.



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A wide range of assumptions can apply to the simple variable model described here. The overall sensitivity to assumptions is examined in **Table #5F, Effect of Assumptions of Occupancy Probability on Estimates of Take of Occupied Habitat in Southern Humboldt**. There, seven case are compared. The table lists the probability assigned to the variables of location, OGR type, and survey status. Because of the varying assumptions for park land, the total likely occupied acreage for Southern Humboldt varies widely. Because the impact of harvest also varies, the harvest expressed as a percent of Southern Humboldt falls in a fairly narrow range even with widely different assumptions. The reasonable low and high end of this range is 17% to 23%.

Summarizing this series of analyses, we estimate that the loss of OGR allowed under the HCP would amount to from 17% to 23% of the occupied habitat in the Southern Humboldt Bioregion. Work done by C.J. Ralph's team at Redwood Sciences Lab indicate that there is distinctly higher value in the Headwaters and MCAs than in other areas which would be harvested under the HCP. It may be that there is more concentrated Marbled murrelet use in the MCAs and there may be more Marbled murrelet use in the Humboldt Redwood State Park than is assumed, and these conditions would reduce the estimate of habitat take.

The habitat loss on PL land is placed in context by **Table #5G, All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take, in Context**. Table #5G compares area available for harvest with habitat estimates for MMCZ4 and the three state region. Three perspectives are given, the first column shows the gross OGR area, with no estimate of actual area occupied and no relative weighting of uncut and residual. The next two columns give the lower and the higher occupancy weighted estimates. Because the occupancy weighted estimates change the area values for PL and the State Park, the denominator for Southern Humboldt and for MMCZ4 is adjusted. In context, the lower and higher estimates of habitat loss translate to a 2.6% to 3.7% loss of habitat in MMCZ4 and 0.5% to 0.7% loss of habitat in the three-state range. The weakness of this comparison is the need to assume that OGR habitat on PL land (and in Southern Humboldt) is comparable on an acre-for-acre basis with other, typically non-redwood habitat elsewhere.

Loss of terrestrial nesting habitat will have population impacts, but the nature of the effect is not easily predicted. Different conjecture leads to predictions of either minimal effect or catastrophic effect. The simplest assumption is that there is a one-to-one relationship between habitat loss and the corresponding steady-state population at-sea. Estimating the equivalent number of adult birds corresponding to terrestrial habitat loss is not directly meaningful because it does not mean that this number of birds will be "taken" as individuals.

The equivalent number of adult birds does allow an alternative way to compare impact on Southern Humboldt with the remainder of the range. **Table #5H, Population-based Estimates of Take, in Context** takes the lower and higher percentage estimates for habitat loss and applies them to the assumed 1,479



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population estimate for the Southern Humboldt Bioregion, at-sea. The resulting population estimate “subject to harvest” can be compared against population estimates for MMCZ4 and the three-state range. This form of comparison allows a somewhat speculative population impact on PL land to be compared directly with population estimates elsewhere and side-steps the problem of comparability of habitat across the range.

Table #5I, All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take, in Context - Harvest Neither Owl or Grizzley and Table #5J, Population-based Estimates of Take, in Context - Harvest Neither Owl or Grizzley apply the same analysis to the scenario created by AB 1986 where neither Owl or Grizzley would be harvested. The higher and lower occupied habitat loss falls from 3,200 to 4,800 acres down to 2,900 to 4,200 acres, or expressed as a proportion of Southern Humboldt County, from a range of 17% to 23% down to 16% to 20%.

Alternative 4 (“63k”)

The EIS/EIR analyzes the effect of establishing a much larger reserve around the Headwaters Forest roughly corresponding to critical habitat. This reserve would be some 63,700 acres (“63k”) and is named Alternative 4 in the EIS/EIR. **Tables 6.A through 6.E** recapitulate the analysis of take for the proposed HCP for Alternative 4.

Alternative 4 would preserve slightly more uncut OGR than the HCP (4,651 ac compared with from 4,321 to 4,638 ac), but would add 2,300 to 2,800 ac of residual. Table 6. A and 6. B show that the total acreage of all OGR types (uncut and residual) available for harvest under Alternative 4 would be 6,880 ac or 39% of all OGR on PL land, 17% of all OGR in Southern Humboldt.

Applying the estimated likelihood of murrelet occupancy methodology, we estimate that Alternative 4 would allow harvest of from 2,200 to 3,400 acres of occupied habitat, all outside of critical habitat. This corresponds to a take of from 12% to 16% of habitat in Southern Humboldt County. In context, the lower and higher estimates of habitat loss translate to a 1.8% to 2.7% loss of habitat in MMCZ4 and 0.3% to 0.5% loss of habitat in the three-state range. Using the equivalent population, the take estimate for the three-state range is 0.6% to 1.4% (Table 6.E).

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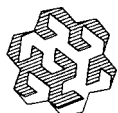
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Pacific Lumber HCP

1. A Summary of Old Growth Redwood and HCP Status

Area in acres

	Other	OG Doug Fir	REDOG w1	REDOG w2	REDOG w3	All Uncut OGR	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
PL Lands											
Avail for Harvest	176,225	8,304	203	217	81	501	264	8,057	8,321	8,823	193,352
Buffer Zones											
buf1320	1,632					0		205	205	205	1,837
buf300	331					0		90	90	90	421
MCA Options											
Grizzly	410		73	44		117	48	482	530	647	1,057
Owl Crk	350	19	240	77		317	10	230	239	556	925
MCA Reserve											
Allen Crk	740		267	68	59	393	20	575	595	988	1,729
B Rd 7&9	232				21	21	14	224	239	260	492
Bell Lawrence	187		315	24		339		107	107	446	634
Booths Run	403	166				0	1	215	216	216	784
Cooper Mill	307					0	151	245	397	397	704
Elkhead Residual	286					0		65	65	65	351
LNF Elk	214					0	36	201	237	237	451
Rd 3	189					0	19	355	374	374	564
Rt Rd 9	128		71		6	77		112	112	190	318
Shaw Gift	162	31	250	6		255		54	54	310	503
MCA reserve Subtotal	2,849	197	902	98	86	1,087	242	2,155	2,397	3,483	6,529
HCP Reserve Options											
Preserve Grizzly	3,259	197	976	142	86	1,204	290	2,636	2,927	4,131	7,586
Preserve Owl	3,199	216	1,142	175	86	1,404	252	2,384	2,636	4,040	7,454
Preserve Both	3,609	216	1,215	220	86	1,521	300	2,866	3,166	4,687	8,511
Headwaters	1,927		2,288	584	245	3,117	0	664	665	3,782	5,709
PL TOTAL	183,724	8,519	3,706	1,021	413	5,139	565	11,882	12,447	17,586	209,830

1. A (Continued)

	Other	OG Fir	Doug W1	REDOG w 2	REDOG w 3	All Uncut OGR	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
ERTC Lands											
Avail for Harvest	7,674					0			0	0	7,674
Buffer Zones											
buf300	26					0			0	0	26
Headwaters	1,769					0			0	0	1,769
ERTC Conserved	1,769		0	0	0	0	0	0	0	0	1,769
ERTC TOTAL	9,469					-0				0	9,469
HCP Study Area TOTAL	193,193	8,519	3,706	1,021	413	5,139	565	11,882	12,447	17,586	219,299
ALL HCP and Purchase Conservation											
Preserve Grizzly	6,955	197	3,264	726	332	4,321	291	3,301	3,591	7,913	15,064
Preserve Owl	6,895	216	3,430	759	332	4,521	252	3,049	3,301	7,822	14,932
Preserve Both	7,305	216	3,503	803	332	4,638	301	3,530	3,831	8,469	15,989
ALL Available for Harvest											
Option Cut Grizzly	186,299	8,304	276	262	81	619	312	8,834	9,146	9,765	204,367
Option Cut Owl	186,238	8,323	442	295	81	818	274	8,582	8,855	9,674	204,235
Cut Neither	185,889	8,304	203	217	81	501	264	8,352	8,616	9,117	203,310

Notes for Summary of Old Growth Redwood and HCP Status

Avail for Harvest	Available for harvest planning, not taking into account watercourse protection
Buffer Zones	Restricted harvest to protect adjacent old growth habitat on public lands.
buf1320	within 1/4 mile of HRSP, seasonal restrictions only, can be clearcut.
buf300	within 300 feet of old growth off-site, 240 sf basal area selective harvest, cannot be clearcut.
MCA	Murrelet Conservation Area per boundaries of July 1998 HCP.
MCA Options	Either Owl Crk MCA or Grizzly Creek MCA would be available for harvest if the other is conserved.
Headwaters	Proposed Headwaters purchase area.
ERTC TOTAL	Elk River Timber Company lands involved in Headwaters purchase/land exchange.
ALL HCP and Purchase Conservation Area	with old growth redwood protected under the Headwaters purchase and PL HCP. Excludes buffer areas.
Old Growth Redwood (OGR)	EDOGW1 Uncut, Canopy over 75% cover
	REDOGW2 Uncut, Canopy 50% to 75%
	REDOGW3 Uncut, Canopy under 50%
	REDRSD2 Residual 15 to 30 trees per acre
	REDRSD3 Residual under 15 trees per acre
	No area is mapped with over 30 residual trees per acre

Pacific Lumber HCP

1. B Distribution of Old Growth Redwood by Timber Volume Density (Mbf/ac) by HCP Status

Area (acres) in OGR Timber Density Class

		Mbf/ac:	<25	25to50	50to100	100 to 150	150 to 200	>200	Total
Uncut OGR									
	Available		0	54	81	578	94	11	818
	HCP		0	11	86	984	123	0	1,204
	HW		0	13	245	510	1,480	870	3,117
	Total		0	77	413	2,072	1,698	880	5,140
Residual OGR									
	Available		3,357	5,339	192	7	0	0	8,895
	HCP		120	2,557	250	0	0	0	2,927
	HW		0	615	50	0	0	0	665
	Total		3,477	8,511	492	7	0	0	12,487

Percent of Total for HCP Status Category in each Density Class (Percent of Row)

Uncut OGR									
	Available		0.0%	6.6%	9.9%	70.7%	11.5%	1.3%	100.0%
	HCP		0.0%	0.9%	7.2%	81.7%	10.2%	0.0%	100.0%
	HW		0.0%	0.4%	7.9%	16.3%	47.5%	27.9%	100.0%
Residual OGR									
	Available		37.7%	60.0%	2.2%	0.1%	0.0%	0.0%	100.0%
	HCP		4.1%	87.4%	8.5%	0.0%	0.0%	0.0%	100.0%
	HW		0.0%	92.5%	7.5%	0.0%	0.0%	0.0%	100.0%

Percent of each Density Class in HCP Status Category (Percent of Column)

Uncut OGR									
	Available		69.4%	19.7%	27.9%	5.6%	1.2%	15.9%	
	HCP		14.1%	20.9%	47.5%	7.2%	0.0%	23.4%	
	HW		16.5%	59.4%	24.6%	87.2%	98.8%	60.7%	
			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Residual OGR									
	Available		96.6%	62.7%	39.0%			71.2%	
	HCP		3.4%	30.0%	50.8%			23.4%	
	HW		0.0%	7.2%	10.2%			5.3%	
			100.0%	100.0%	100.0%			100.0%	

Available reflects option to cut Owl Crk

HCP is area conserved under proposed permit and excludes buffers.

HW is Headwaters purchase

Timber volume data are from the Oct 97 coverage, updated to Mar 98 by TRA.

The "update" includes some 40 acres of area shown as residual OGR which is "other", not OGR in the Mar98 coverage. For consistency, the sum of residual OGR is 12,447 ac.

Pacific Lumber HCP

1. C Old Growth Forest Types and HCP Status in-and-outside of Critical Habitat

	Other	OG Doug Fir	REDOG W1	REDOG W2	REDOG W3	All Uncut OG	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
Area (acres) of Each Forest Type In- or Not in- Critical Habitat											
In Critical Habitat											
Option Cut Grizzly	21,837	31	96	9	14	119	81	1,688	1,769	1,888	23,756
Option Cut Owl	22,178	50	336	84	14	434	91	1,917	2,008	2,442	24,670
Cut Neither	21,837	31	96	9	14	119	81	1,688	1,769	1,888	23,756
TOTAL in Critical Habitat	27,439	254	3,520	756	346	4,621	295	4,364	4,658	9,280	36,973
NOT In Critical Habitat											
Option Cut Grizzly	159,069	8,307	179	253	67	500	231	7,180	7,411	7,911	175,286
Option Cut Owl	158,667	8,307	106	211	67	385	183	6,698	6,881	7,266	174,240
Cut Neither	158,659	8,307	106	209	67	382	183	6,698	6,881	7,264	174,229
TOTAL NOT in Critical Habitat	165,672	8,307	186	265	67	518	270	7,558	7,829	8,347	182,326
All HCP Planning Area, Including Headwaters											
Option Cut Grizzly	180,905	8,338	276	262	81	619	312	8,868	9,180	9,799	199,041
Option Cut Owl	180,845	8,356	442	295	81	818	274	8,616	8,890	9,708	198,909
Cut Neither	180,495	8,338	203	217	81	501	264	8,386	8,650	9,151	197,984
TOTAL in HCP Area	193,111	8,561	3,706	1,021	413	5,140	565	11,922	12,487	17,627	219,298
% of All of Each Forest Type in Available Area which is also in Critical Habitat											
Option Cut Grizzly	11.3%	0.4%	2.6%	0.9%	3.4%	2.3%	14.3%	14.2%	14.2%	10.7%	10.8%
Option Cut Owl	11.5%	0.6%	9.1%	8.2%	3.4%	8.4%	16.1%	16.1%	16.1%	13.9%	11.2%
Cut Neither	11.3%	0.4%	2.6%	0.9%	3.4%	2.3%	14.3%	14.2%	14.2%	10.7%	10.8%
% of All of Each Forest Type within Critical Habitat which is in Available Area											
Option Cut Grizzly	79.6%	12.2%	2.7%	1.2%	4.0%	2.6%	27.5%	38.7%	38.0%	20.3%	64.3%
Option Cut Owl	80.8%	19.6%	9.5%	11.1%	4.0%	9.4%	30.9%	43.9%	43.1%	26.3%	66.7%
Cut Neither	79.6%	12.2%	2.7%	1.2%	4.0%	2.6%	27.5%	38.7%	38.0%	20.3%	64.3%
% of All of Each Forest Type in Entire Study Area which is in Available Area											
Option Cut Grizzly	93.7%	97.4%	7.4%	25.6%	19.7%	12.0%	55.3%	74.4%	73.5%	55.6%	90.8%
Option Cut Owl	93.6%	97.6%	11.9%	28.9%	19.7%	15.9%	48.5%	72.3%	71.2%	55.1%	90.7%
Cut Neither	93.5%	97.4%	5.5%	21.3%	19.7%	9.8%	46.8%	70.3%	69.3%	51.9%	90.3%

Note: Area available for harvest includes buffers, but does not subtract area of watercourse protection.

Option indicates PL option to cut either Owl Crk or Grizzly Complex under July 1998 Draft HCP.

Analysis based on Oct 97 coverage, updated to Mar 98 by TRA, includes 40 acres of residual OGR not in the PL Mar98 coverage.

For consistency with other tables, the sum of residual OGR is 12,447 ac.

2. Pacific Lumber HCP

Marbled Murrelet Survey Counts at Stations, by Result

Number of Surveys	Number of Stations with this number of surveys			Cumulative number of stations			% of all sites in class with this many or more surveys		
	Occupied	Present	Not Detected	Occupied	Present	Not Detected	Occupied	Present	Not Detected
1	35	83	279	35	83	279	100.00%	100.00%	100.00%
2	5	14	62	40	97	341	78.53%	64.22%	40.38%
3	2	10	19	42	107	360	75.46%	58.19%	27.14%
4	4	8	33	46	115	393	74.23%	53.88%	23.08%
5	3	6	9	49	121	402	71.78%	50.43%	16.03%
6	32	38	19	81	159	421	69.94%	47.84%	14.10%
7	7	21	7	88	180	428	50.31%	31.47%	10.04%
8	3	7	22	91	187	450	46.01%	22.41%	8.55%
9	6	3	7	97	190	457	44.17%	19.40%	3.85%
10	15	5		112	195	457	40.49%	18.10%	2.35%
11	4	5	1	116	200	458	31.29%	15.95%	2.35%
12	4	4	3	120	204	461	28.83%	13.79%	2.14%
13	9	8	1	129	212	462	26.38%	12.07%	1.50%
14	19	7	3	148	219	465	20.86%	8.62%	1.28%
15	8	4	1	156	223	466	9.20%	5.60%	0.64%
16	5	1		161	224	466	4.29%	3.88%	0.43%
17	1			162	224	466	1.23%	3.45%	0.43%
18		1		162	225	466	0.61%	3.45%	0.43%
19		1	1	162	226	467	0.61%	3.02%	0.43%
20		1		162	227	467	0.61%	2.59%	0.21%
21			1	162	227	468	0.61%	2.16%	0.21%
22		2		162	229	468	0.61%	2.16%	0.00%
23		2		162	231	468	0.61%	1.29%	0.00%
24	1	1		163	232	468	0.61%	0.43%	0.00%
Class total	163	232	468						
% of all sites	19%	27%	54%						
All Sites	863								

TRA Version 05/20/98

Source: Redwood Sciences Lab, data through 1997.

Pacific Lumber HCP

3. A Old Growth and Marbled Murrelet Survey Status

Area (acres) by Forest Type within ½ mile radius of Survey Sites

[illegible]

3. A (Continued)

[illegible]

3. A (Continued)

Total		Other	OG Doug Fir	REDOG W1	REDOG W2	REDOG W3	All Uncut OGR	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
PL	no restrict	176,225	8,304	203	217	81	501	264	8,057	8,321	8,823	193,352
	buf1320	1,632	0	0	0	0	0	0	205	205	205	1,837
	buf300	331	0	0	0	0	0	0	90	90	90	421
	All MCA	3,609	216	1,215	220	86	1,521	300	2,866	3,166	4,687	8,511
	<i>HCP Subtotal</i>	<i>5,572</i>	<i>216</i>	<i>1,215</i>	<i>220</i>	<i>86</i>	<i>1,521</i>	<i>300</i>	<i>3,161</i>	<i>3,461</i>	<i>4,982</i>	<i>10,769</i>
	HW	1,927	0	2,288	584	245	3,117	0	664	665	3,782	5,709
	<i>MM Cons. Planning</i>	<i>7,499</i>	<i>216</i>	<i>3,503</i>	<i>803</i>	<i>332</i>	<i>4,638</i>	<i>301</i>	<i>3,825</i>	<i>4,125</i>	<i>8,764</i>	<i>16,478</i>
	All PL	183,724	8,519	3,706	1,021	413	5,140	565	11,882	12,447	17,586	209,830
ERTC	no restrict	7,674	0	0	0	0	0	0	0	0	0	7,674
	buf300	26	0	0	0	0	0	0	0	0	0	26
	HW	1,769	0	0	0	0	0	0	0	0	0	1,769
	<i>MM Cons. Planning</i>	<i>1,795</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>1,795</i>
	All ERTC	9,469	0	0	0	0	0	0	0	0	0	9,469

Notes: Murrelet "Occupied" takes precedence over "Present", which is over "Not Detected"
 Thus if an area was within ½ mile of an occupied site and a present site, it is tallied as occupied.
 Old growth redwood and old growth doug fir are tallied. All other forest cover is under category "other".
 no restrict No murrelet restrictions on harvest planning, does not take into account watercourse protection
 buf1320 within 1/4 mile of HRSP
 buf300 within 300 feet of old growth off-site
 All MCA In a MCA per boundaries 6.1, does not distinguish HCP Owl Crk v. Grizzley Option.
HCP Subtotal All of HCP conservation provisions for murrelet, includes both Owl and Grizzley MCA
 HW In Headwaters purchase area
 ERTC Elk River Timber Company land involved in Headwaters purchase and land exchange
MM Cons. Planning Total area subject to murrelet conservation planning: All MCA and buffers, plus Headwaters
 TRA Version 09/22/98

Pacific Lumber HCP

3. B Forest Type and Marbled Murrelet Survey Status in State Parks

Area (acres) of Forest type within ½ mile of murrelet survey stations, by survey status

	Humboldt Redwood St. Park (HRSP)					Grizzley Creek St. Park				
	Not Surveyed	Occupied	Present	Not Detected	TOTAL	Not Surveyed	Occupied	Present	Not Detected	TOTAL
O1	1,945	2,989	2,582	3,935	11,453	187	95	1		283
O2	249	81	200	791	1,321	4				4
OY1	918	708	687	1,982	4,295	5	61	1		67
OY2	799	317	403	1,359	2,879	8				8
Uncut Type	3,913	4,095	3,873	8,067	19,948	204	155	2	0	362
R1	83		10	202	296					
R2	929	96	48	1,397	2,471					
RY1				71	71					
RY2	256	0	55	180	491		25			25
Residual	1,268	96	113	1,851	3,328	0	25	0	0	25
All OGR	5,181	4,191	3,986	9,918	23,276	204	181	2	0	387
N	6,948	786	260	2,002	9,996	350	83	10	19	462
NC	686			590	1,276					
P	6,453	137	149	2,992	9,730	32	2		2	36
Y1	1,751	243	57	1,078	3,129	69			2	71
Y2	1,082	53	27	541	1,702	3				3
Other	16,919	1,218	494	7,202	25,833	455	85	10	23	572
All Area	22,099	5,410	4,480	17,120	49,109	659	265	12	23	959

Summary: Both State Parks

	Not Surveyed	Occupied	Present	Not Detected	TOTAL
Uncut Type	4,117	4,250	3,875	8,067	20,310
Residual	1,268	122	113	1,851	3,354
All OGR	5,385	4,372	3,988	9,918	23,663

Pacific Lumber HCP

4. A Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status

Survey Status within ½ mile radius of Survey Stations

			Not OG Redwood	All OGR Contiguous with Occupied Station					Old Growth Redwood, Not Contiguous					TOTAL	
				Occupied	Present	Not Detected	Not Surveyed	TOTAL	Occupied	Present	Not Detected	Not Surveyed	TOTAL		
PL	no restrict		184,529	2,090	916	111	31	3,148	161	547	3,415	1,552	5,675	193,352	
	buf1320		1,632	106	10			116		63	4	22	89	1,837	
	buf300		331	37				37		43	8	1	53	421	
	grv	Allen Crk	740	907	47	33	1	988							1,729
		B Rd 7&9	232	243	17			260							492
		Bell Lawrence	187	425	9		13	446							634
		Booths Run	568	161	55			216							784
		Cooper Mill	307	364	24	0		389	3	3	2			8	704
		Elkhead Residual	286	65				65							351
		Grizzley	410	465	28		3	496	83	68				151	1,057
		LNF Elk	214	237	0			237							451
		Owl Crk	369	522	34			556							925
		Rd 3	189	373		1	1	374							564
		Rt Rd 9	128	189	1			190							318
		Shaw Gift	193	310				310							503
		MCA Subtotal	3,824	4,260	216	34	17	4,527	86	72	2			160	8,511
		HW	hdwtr	1,927	3,253	308	152	39	3,752	1	5	5	19	30	5,709
	TOTAL		192,244	9,747	1,450	297	86	11,580	248	730	3,434	1,594	6,006	209,830	
	ERTC	no restrict		7,674											7,674
		buf300		26											26
hdwtr		hdwtr	1,769											1,769	
TOTAL		9,469											9,469		
HCP Study Area			201,713	9,747	1,450	297	86	11,580	248	730	3,434	1,594	6,006	219,299	

Notes: Murrelet Occupied takes precedence over Present, which takes precedence over Not Detected
 Thus if an area was within ½ mile of an occupied site and a present site, it is tallied as occupied.
 Only old growth redwood is tallied. All other cover is under category "other".
 OGR Includes both uncut and residual Old Growth Redwood.
 no restrict No murrelet restrictions on harvest planning, does not take into account watercourse protection.
 buf1320 Seasonal harvest restrictions within 1/4 mile of HRSP.
 buf300 Selection cut (no clear-cut) within 300 feet of public old growth redwood off-site.
 ERTC Elk River Timber Company land involved in Headwaters purchase and land exchange

4. B Pacific Lumber HCP

Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status — HCP Summary

Survey Status within ½ mile radius of Survey Stations

Available for Harvest		Not OG Redwood	OGR Contiguous with Occupied Station					Old Growth Redwood, Not Contiguous					TOTAL
			Occupied	Present	Not Detected	Not Surveyed	TOTAL	Occupied	Present	Not Detected	Not Surveyed	TOTAL	
PL	no restriction	184,529	2,090	916	111	31	3,148	161	547	3,415	1,552	5,675	193,352
	all buffers	1,963	143	10	0	0	153	0	106	12	24	142	2,258
	HCP Harvest Options												
	Grizzley	410	465	28		3	496	83	68			151	1,057
	Owl Crk	369	522	34			556						925
	Harvest Grizzley Option	186,902	2,698	955	111	33	3,797	244	721	3,427	1,576	5,968	196,667
	Harvest Owl Crk Option	186,861	2,755	961	111	31	3,857	161	653	3,427	1,576	5,816	196,535
	Harvest Neither	186,492	2,233	927	111	31	3,301	161	653	3,427	1,576	5,816	195,610
	All HCP Study Area	201,713	9,747	1,450	297	86	11,580	248	730	3,434	1,594	6,006	219,299

OGR Harvest by Status	OGR Contiguous with Occupied Station		Old Growth Redwood, Not Contiguous			All OGR
	All Contig. OGR	w/in ½ mi of Occupied	All Not Contig. OGR	w/in ½ mi of Occupied	Not w/in ½ mi of Surveyed	
Harvest Grizzley Option	3,797	2,698	5,968	244	1,576	9,765
As % of All Study Area	33%	28%	99%	98%	99%	56%
Harvest Owl Crk Option	3,857	2,755	5,816	161	1,576	9,674
As % of All Study Area	33%	28%	97%	65%	99%	55%
Harvest Neither	3,301	2,233	5,816	161	1,576	9,117
As % of All Study Area	29%	23%	97%	65%	99%	52%
All HCP Study Area	11,580	9,747	6,006	248	1,594	17,586

Notes: no restriction
all buffers
OGR

No murrelet restrictions on harvest planning, does not take into account watercourse protection.
300 foot selection cut and 1/4 mile seasonal restriction buffers are considered available for harvest.
Includes both uncut and residual Old Growth Redwood.

Pacific Lumber HCP

5. A Old Growth Redwood Timber Coverage and Occupancy

(acres)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Area Subject to Harvest									
Option Cut Grizzley	213	406	619	2,485	6,661	9,146	2,698	7,067	9,765
Option Cut Owl	449	369	818	2,306	6,549	8,856	2,755	6,919	9,674
Cut Neither	150	351	501	2,083	6,533	8,616	2,233	6,884	9,117
Context Area									
PL not HW	1,587	436	2,022	4,907	6,875	11,782	6,493	7,311	13,804
HW	2,643	474	3,117	610	55	665	3,253	529	3,782
All PL	4,230	910	5,139	5,517	6,930	12,447	9,747	7,840	17,586
St Park	4,250	16,059	20,310	122	3,232	3,354	4,372	19,291	23,663
So Hum	8,480	16,969	25,449	5,639	10,162	15,800	14,119	27,131	41,250
Harvest									
As % of PL not HW									
Option Cut Grizzley	13.4%	93.2%	30.6%	50.6%	96.9%	77.6%	41.6%	96.7%	70.7%
Option Cut Owl	28.3%	84.8%	40.5%	47.0%	95.3%	75.2%	42.4%	94.6%	70.1%
Cut Neither	9.4%	80.7%	24.8%	42.5%	95.0%	73.1%	34.4%	94.2%	66.0%
As % of All PL									
Option Cut Grizzley	5.0%	44.6%	12.0%	45.0%	96.1%	73.5%	27.7%	90.1%	55.5%
Option Cut Owl	10.6%	40.6%	15.9%	41.8%	94.5%	71.1%	28.3%	88.3%	55.0%
Cut Neither	3.5%	38.6%	9.8%	37.8%	94.3%	69.2%	22.9%	87.8%	51.8%
As % of So Hum									
Option Cut Grizzley	2.5%	2.4%	2.4%	44.1%	65.5%	57.9%	19.1%	26.0%	23.7%
Option Cut Owl	5.3%	2.2%	3.2%	40.9%	64.4%	56.0%	19.5%	25.5%	23.5%
Cut Neither	1.8%	2.1%	2.0%	36.9%	64.3%	54.5%	15.8%	25.4%	22.1%

Available for harvest does not reflect restrictions in public OGR buffers and watercourse protection zones.

TRA Version 09/08/98

Pacific Lumber HC

5. A rev Old Growth Redwood Timber Coverage and Occupancy – Revision changes: Area in Buffers Removed

	Uncut OGR			Residual OGR			All Residual	All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey			Presumed Occupied	Low/No Survey	All OGR
Option Cut Grizzly	0	0	0	(143)	(152)	(295)		(143)	(152)	(295)
Option Cut Owl	0	0	0	(143)	(152)	(295)		(143)	(152)	(295)

In application, harvest of Grizzly Creek MCA under option would be subject to 300 foot buffer around OGR in State Park.
 TRA Version 09/08/98

Pacific Lumber HCP

5. B Probability That OGR Habitat is Occupied based on Survey Status, OGR Type, and Location

Case 1: Uniform Assumptions — All Low/No Survey is 25% probability

OGR Type:	Uncut OGR		Residual OGR	
Survey Status:	Presumed Occupied	Low/No Survey	Presumed Occupied	Low/No Survey
Option Cut Grizzley	100%	25%	100%	25%
Option Cut Owl	100%	25%	100%	25%
PL not HW	100%	25%	100%	25%
HW All PL	100%	25%	100%	25%
State Park	100%	25%	100%	25%

TRA Version 07/31/98

Pacific Lumber HCP

5. C Potential Marbled Murrelet Occupied Habitat

Case 1: Uniform Assumptions — All Low/No Survey is 25% probability

(acres of occupied habitat)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Area Subject to Harvest									
Option Cut Grizzly	213	101	314	2,485	1,665	4,150	2,698	1,767	4,465
Option Cut Owl	449	92	541	2,306	1,637	3,944	2,755	1,730	4,485
Cut Neither	150	88	238	2,083	1,633	3,716	2,233	1,721	3,954
Context Area									
PL not HW	1,587	109	1,695	4,907	1,719	6,626	6,493	1,828	8,321
HW	2,643	119	2,762	610	14	624	3,253	132	3,385
All PL	4,230	227	4,457	5,517	1,732	7,249	9,747	1,960	11,706
St Park	4,250	4,015	8,265	122	808	930	4,372	4,823	9,195
So Hum	8,480	4,242	12,722	5,639	2,540	8,179	14,119	6,783	20,901
Harvest									
As % of PL not HW									
Option Cut Grizzly	13.4%	93.2%	18.5%	50.6%	96.9%	62.6%	41.6%	96.7%	53.7%
Option Cut Owl	28.3%	84.8%	31.9%	47.0%	95.3%	59.5%	42.4%	94.6%	53.9%
Cut Neither	9.4%	80.7%	14.0%	42.5%	95.0%	56.1%	34.4%	94.2%	47.5%
As % of All PL									
Option Cut Grizzly	5.0%	44.6%	7.0%	45.0%	96.1%	57.3%	27.7%	90.1%	38.1%
Option Cut Owl	10.6%	40.6%	12.1%	41.8%	94.5%	54.4%	28.3%	88.3%	38.3%
Cut Neither	3.5%	38.6%	5.3%	37.8%	94.3%	51.3%	22.9%	87.8%	33.8%
As % of So Hum									
Option Cut Grizzly	2.5%	2.4%	2.5%	44.1%	65.5%	50.7%	19.1%	26.0%	21.4%
Option Cut Owl	5.3%	2.2%	4.3%	40.9%	64.4%	48.2%	19.5%	25.5%	21.5%
Cut Neither	1.8%	2.1%	1.9%	36.9%	64.3%	45.4%	15.8%	25.4%	18.9%

Pacific Lumber HCP

5. D Probability That OGR Habitat is Occupied based on Survey Status, OGR Type, and Location

Case 2: PL Centered Assumptions — All PL Uncut OGR is 100%, State Park Low/No Survey is 0% probability

OGR Type:	Uncut OGR		Residual OGR	
	Survey Presumed Status: Occupied	Low/No Survey	Presumed Occupied	Low/No Survey
Option Cut Grizzly	100%	100%	100%	25%
Option Cut Owl	100%	100%	100%	25%
PL not HW	100%	100%	100%	25%
HW All PL	100%	100%	100%	25%
State Park	100%	0%	100%	0%

TRA Version 07/31/98

Pacific Lumber HCP

5. E Potential Marbled Murrelet Occupied Habitat

Case 2: PL Centered Assumptions — All PL Uncut OGR is 100%, State Park Low/No Survey is 0% probability

(acres of occupied habitat)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Area Subject to Harvest									
Option Cut Grizzly	213	406	619	2,485	1,665	4,150	2,698	2,071	4,769
Option Cut Owl	449	369	818	2,306	1,637	3,944	2,755	2,007	4,762
Cut Neither	150	351	501	2,083	1,633	3,716	2,233	1,985	4,218
Context Area									
PL not HW	1,587	436	2,022	4,907	1,719	6,626	6,493	2,154	8,648
HW	2,643	474	3,117	610	14	624	3,253	488	3,741
All PL	4,230	910	5,139	5,517	1,732	7,249	9,747	2,642	12,389
St Park	4,250	0	4,250	122	0	122	4,372	0	4,372
So Hum	8,480	910	9,390	5,639	1,732	7,371	14,119	2,642	16,761
Harvest									
As % of PL not HW									
Option Cut Grizzly	13.4%	93.2%	30.6%	50.6%	96.9%	62.6%	41.6%	96.1%	55.1%
Option Cut Owl	28.3%	84.8%	40.5%	47.0%	95.3%	59.5%	42.4%	93.1%	55.1%
Cut Neither	9.4%	80.7%	24.8%	42.5%	95.0%	56.1%	34.4%	92.1%	48.8%
As % of All PL									
Option Cut Grizzly	5.0%	44.6%	12.0%	45.0%	96.1%	57.3%	27.7%	78.4%	38.5%
Option Cut Owl	10.6%	40.6%	15.9%	41.8%	94.5%	54.4%	28.3%	75.9%	38.4%
Cut Neither	3.5%	38.6%	9.8%	37.8%	94.3%	51.3%	22.9%	75.1%	34.0%
As % of So Hum									
Option Cut Grizzly	2.5%	44.6%	6.6%	44.1%	96.1%	56.3%	19.1%	78.4%	28.5%
Option Cut Owl	5.3%	40.6%	8.7%	40.9%	94.5%	53.5%	19.5%	75.9%	28.4%
Cut Neither	1.8%	38.6%	5.3%	36.9%	94.3%	50.4%	15.8%	75.1%	25.2%

Pacific Lumber HCP

5. F Effect of Assumptions of Occupancy Probability on Estimated Take in Southern Humboldt

			Case						
			1	2	3	4	5	6	7
Location	OGR Type	Survey Status	Uniform Assumpt.	PL Centered	All PL Uncut is Occupied	All Uncut is Occupied	Habitat Quality Weight for Uncut	Straight Area: All OGR is Habita	Only Uncut OGR is Habitat
PL Lands, including HW			(Probability of occupancy)						
Uncut	Presumed Occupied		100%	100%	100%	100%	100%	100%	100%
		Low/No Survey	25%	100%	100%	100%	100%	100%	100%
Residual	Presumed Occupied		100%	100%	100%	100%	35%	100%	0%
		Low/No Survey	25%	25%	25%	25%	25%	100%	0%
State Park Lands									
Uncut	Presumed Occupied		100%	25%	100%	100%	100%	100%	100%
		Low/No Survey	25%	0%	25%	100%	25%	100%	100%
Residual	Presumed Occupied		100%	25%	100%	100%	35%	100%	0%
		Low/No Survey	25%	0%	25%	25%	25%	100%	0%
Harvest Percent			(Take as percent of Southern Humboldt)						
Option Cut Grizzly			21.4%	28.5%	22.1%	14.2%	17.6%	23.7%	2.4%
Option Cut Owl			21.5%	28.4%	22.1%	14.2%	18.2%	23.5%	3.2%
Cut Neither			18.9%	25.2%	19.5%	12.5%	16.0%	22.1%	2.0%
Harvest Area			(Area in acres of Effectively Occupied Habitat)						
Option Cut Grizzly			4,465	4,769	4,769	4,769	3,154	9,765	619
Option Cut Owl			4,485	4,762	4,762	4,762	3,263	9,674	818
Cut Neither			3,954	4,218	4,218	4,218	2,864	9,117	501
Context									
PL Not HW			8,321	8,648	8,648	8,648	5,458	13,804	2,022
All PL			11,706	12,389	12,389	12,389	8,803	17,586	5,139
Southern Humboldt			20,901	16,761	21,584	33,628	17,919	41,250	25,449
				Higher		Lower	All OGR		

Pacific Lumber HCP

5. G All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take in Context
Effective Occupied Habitat (acres, rounded) and Harvest as % of Context

	All OGR		Occupancy Weighted Estimate			
			Lower Estimate		Higher Estimate	
Context	Acres	Harvest %	Acres	Harvest %	Acres	Harvest %
Subject to Harvest	9,700		3,200		4,800	
PL Not HW	13,800	70.3%	5,500	58.2%	8,600	55.8%
All PL	17,600	55.1%	8,800	36.4%	12,400	38.7%
Southern Humboldt	41,200	23.5%	17,900	17.9%	21,600	22.2%
California	90,500	10.7%	67,200	4.8%	70,900	6.8%
MMCZ 4	147,800	6.6%	124,500	2.6%	128,200	3.7%
Three State	700,000	1.4%	700,000	0.5%	700,000	0.7%

Subject to Harvest Rounded values of all harvest, reflecting either Owl or Grizzly cut.

Does not subtract areas within watercourse protection zones.

All OGR Lumps Uncut and Residual OGR forest types (Case 6)

Lower Estimate Reflects 35% habitat quality weighting for Residual OGR (Case 5), rounded.

Higher Estimate All PL Uncut is 100% occupied; State Pk Uncut not w/in ½ mi of occ survey is 25% (Case 3).

Area for Calif. and MMCZ4 adjusted to account for different contribution from Southern Humboldt by case.

Pacific Lumber HCP

5. H Population-based Estimates of Take, in Context

Estimated Population in Birds and Effect of Harvest as % of Context

Overall Population Range:

LOW

HIGH

	Lower Estimate of Take		Higher Estimate of Take		Lower Estimate of Take		Higher Estimate of Take	
	Population	Harvest %	Population	Harvest %	Population	Harvest %	Population	Harvest %
Context								
Subject to Harvest	251		340		251		340	
PL Not HW	na							
All PL	na							
Southern Humboldt	1,479	17.0%	1,479	23.0%	1,479	17.0%	1,479	23.0%
California	4,884	5.1%	4,884	7.0%	4,884	5.1%	4,884	7.0%
MMCZ 4	5,560	4.5%	5,560	6.1%	8,134	3.1%	8,134	4.2%
Three State	16,984	1.5%	16,984	2.0%	30,000	0.8%	30,000	1.1%

Subject to Harvest Assumes Option Cut Owl Crk; Does not subtract areas within watercourse protection zones.

Lower Estimate Assumed to be 17% of Southern Humboldt population, based on lower occupied habitat area.

Higher Estimate Assumed to be 23% of Southern Humboldt population, based on higher occupied habitat area.

Pacific Lumber HCP

5. I All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take in Context
Effective Occupied Habitat (acres, rounded) and Harvest as % of Context
Harvest Neither Owl nor Grizzley

	All OGR		Occupancy Weighted Estimate			
	Acres	Harvest %	Lower Estimate		Higher Estimate	
			Acres	Harvest %	Acres	Harvest %
Subject to Harvest	9,100		2,900		4,200	
Context						
PL Not HW	13,800	65.9%	5,500	52.7%	8,600	48.8%
All PL	17,600	51.7%	8,800	33.0%	12,400	33.9%
Southern Humboldt	41,200	22.1%	17,900	16.2%	21,600	19.4%
California	90,500	10.1%	67,200	4.3%	70,900	5.9%
MMCZ 4	147,800	6.2%	124,500	2.3%	128,200	3.3%
Three State	700,000	1.3%	700,000	0.4%	700,000	0.6%

Subject to Harvest Rounded values of all harvest, with neither Owl nor Grizzley cut.

Does not subtract areas within watercourse protection zones.

All OGR Lumps Uncut and Residual OGR forest types (Case 6)

Lower Estimate Reflects 35% habitat quality weighting for Residual OGR (Case 5), rounded.

Higher Estimate All PL Uncut is 100% occupied; State Pk Uncut not w/in ½ mi of occ survey is 25% (Case 3).

Area for Calif. and MMCZ4 adjusted to account for different contribution from Southern Humboldt by case.

5. J Population-based Estimates of Take, in Context
Estimated Population in Birds and Effect of Harvest as % of Context
Harvest Neither Owl nor Grizzley

Population Estimate Range:

LOW

HIGH

	Lower Estimate of Take		Higher Estimate of Take		Lower Estimate of Take		Higher Estimate of Take	
	Population	Harvest %	Population	Harvest %	Population	Harvest %	Population	Harvest %
Context								
Subject to Harvest	237		296		237		296	
PL Not HW	na							
All PL	na							
Southern Humboldt	1,479	16.0%	1,479	20.0%	1,479	16.0%	1,479	20.0%
California	4,884	4.8%	4,884	6.1%	4,884	4.8%	4,884	6.1%
MMCZ 4	5,560	4.3%	5,560	5.3%	8,134	2.9%	8,134	3.6%
Three State	16,984	1.4%	16,984	1.7%	30,000	0.8%	30,000	1.0%

Subject to Harvest Assumes Option Cut Owl Crk; Does not subtract areas within watercourse protection zones.
 Lower Estimate Assumed to be 16% of Southern Humboldt population, based on lower occupied habitat area.
 Higher Estimate Assumed to be 20% of Southern Humboldt population, based on higher occupied habitat area.

TRA Version 09/22/98

Pacific Lumber HCP

6. A Conservation Status of Forest Types, ALternative 4 ("63k")

	Status Under Alt. 4	Status Under HCP	Other	OG Doug Fir	REDOGW 1	REDOGW 2	REDOGW 3	All Uncut OGR	REDRSD2	REDRSD3	All Residual	All OGR	Total Area
PL	In Alt 4	avail	42,764	114	96	20	14	131	88	2,705	2,793	2,924	45,802
		300buf	30					0			0	0	30
		grv	3,198	216	1,142	175	86	1,404	252	2,385	2,637	4,040	7,454
		hdwtr	1,927		2,288	584	245	3,117	0	664	665	3,782	5,709
		Alt 4 Subtotal	47,919	330	3,527	779	346	4,651	341	5,754	6,095	10,746	58,995
	out	avail	133,380	8,231	106	197	67	371	176	5,392	5,567	5,938	147,549
		1320buf	1,632					0		205	205	205	1,837
		300buf	301					0		90	90	90	391
		grv	410		73	44		117	48	482	530	647	1,057
	PL Total		183,642	8,561	3,706	1,021	413	5,140	565	11,922	12,487	17,626	209,829
SPI	In Alt 4	avail	3,166					0			0	0	3,166
		300buf	26					0			0	0	26
		hdwtr	1,485					0			0	0	1,485
		Alt 4 Subtotal	4,677	0	0	0	0	0	0	0	0	0	4,677
	out	avail	4,508					0			0	0	4,508
		hdwtr	284					0			0	0	284
All Alt 4			52,596	330	3,527	779	346	4,651	341	5,754	6,095	10,746	63,672
Subject to Harvest			135,723	8,231	179	242	67	488	224	6,168	6,392	6,880	150,834
Available as % of all PL			74%	96%	5%	24%	16%	9%	40%	52%	51%	39%	72%

Subject to Harvest: PL land only, excludes land in Alt.4 area but does not exclude public OGR buffer or watercourse protection.

Pacific Lumber HCP

6. B Old Growth Redwood Timber Coverage and Occupancy Under Alternative 4 ("63k")

(acres)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Subject to Harvest	204	284	488	1,652	4,740	6,392	1,856	5,024	6,880
PL not HW	1,587	436	2,022	4,907	6,875	11,782	6,493	7,311	13,804
HW	2,643	474	3,117	610	55	665	3,253	529	3,782
All PL	4,230	910	5,139	5,517	6,930	12,447	9,747	7,840	17,586
St Park	4,250	16,059	20,310	122	3,232	3,354	4,372	19,291	23,663
So Hum	8,480	16,969	25,449	5,639	10,162	15,800	14,119	27,131	41,250
As % of PL not HW									
Alt 4	12.8%	65.3%	24.1%	33.7%	68.9%	54.3%	28.6%	68.7%	49.8%
As % of All PL									
Alt 4	4.8%	31.3%	9.5%	29.9%	68.4%	51.4%	19.0%	64.1%	39.1%
As % of So Hum									
Alt 4	2.4%	1.7%	1.9%	29.3%	46.6%	40.5%	13.1%	18.5%	16.7%

Pacific Lumber HCP

6. C Lower and Higher Occupancy Estimates Under Alternative 4 ("63k")

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Actual Area (acres)	204	284	488	1,652	4,740	6,392	1,856	5,024	6,880
Effective Occupied Area (acres)									
Low: "Case 5"	100%	100%		35%	25%				
Alt 4 Low	204	284	488	578	1,185	1,763	782	1,469	2,251
High: "Case "3"	100%	100%		100%	25%				
Alt 4 High	204	284	488	1,652	1,185	2,837	1,856	1,469	3,325

Lower Estimate

All Uncut OGR is 100% occupied; presumed occupied Residual is given 35% habitat quality occupancy likelihood weighting; Low/No survey Residual OGR is 25% occupied. (Case 5)

Higher Estimate

All PL Uncut and presumed occupied Residual is 100% occupied; Low/No survey Residual is 25% occupied. State Park Uncut not w/in ½ mi of occ survey is 25%. (Case 3)

Pacific Lumber HCP

6. D Old Growth Area, and Lower and Higher Occupancy Weighted Estimates of Take in Context Under Alternative 4 ("63k")
Effective Occupied Habitat (acres, rounded) and Harvest as % of Context

	All OGR		Occupancy Weighted Estimate			
	Acres	Harvest %	Lower Estimate		Higher Estimate	
			Acres	Harvest %	Acres	Harvest %
Subject to Harvest	6,900		2,200		3,400	
Context						
PL Not HW	13,800	50.0%	5,500	40.0%	8,600	39.5%
All PL	17,600	39.2%	8,800	25.0%	12,400	27.4%
Southern Humboldt	41,200	16.7%	17,900	12.3%	21,600	15.7%
California	90,500	7.6%	67,200	3.3%	70,900	4.8%
MMCZ 4	147,800	4.7%	124,500	1.8%	128,200	2.7%
Three State	700,000	1.0%	700,000	0.3%	700,000	0.5%
Subject to Harvest	All PL outside of "63k"; Does not subtract buffers or watercourse protection zones.					
All OGR	Lumps Uncut and Residual OGR forest types regardless of occupancy. (Case 6)					
Lower Estimate	Reflects 35% habitat quality weighting for Residual OGR (Case 5)					
Higher Estimate	All PL Uncut is 100% occupied; State Park Uncut not w/in ½ mi of occ survey is 25% (Case 3)					

Area for Calif. and MMCZ4 adjusted to account for different contribution from Southern Humboldt

Pacific Lumber HCP

6. E Population-based Estimates of Take, in Context Under Alternative 4 ("63k")

Estimated Population in Birds and Effect of Harvest as % of Context

Population Estimate Range:

LOW

HIGH

	Lower Estimate of Take		Higher Estimate of Take		Lower Estimate of Take		Higher Estimate of Take	
	Population	Harvest %	Population	Harvest %	Population	Harvest %	Population	Harvest %
Subject to Harvest	177		237		177		237	
Context								
PL Not HW	na							
All PL	na							
Southern Humboldt	1,479	12.0%	1,479	16.0%	1,479	12.0%	1,479	16.0%
California	4,884	3.6%	4,884	4.8%	4,884	3.6%	4,884	4.8%
MMCZ 4	5,560	3.2%	5,560	4.3%	8,134	2.2%	8,134	2.9%
Three State	16,984	1.0%	16,984	1.4%	30,000	0.6%	30,000	0.8%

Subject to Harvest All PL outside of "63k"; Does not subtract buffers or watercourse protection zones.
 Lower Estimate Assumed to be 12% of Southern Humboldt population, based on lower occupied habitat area.
 Higher Estimate Assumed to be 16% of Southern Humboldt population, based on higher occupied habitat area.

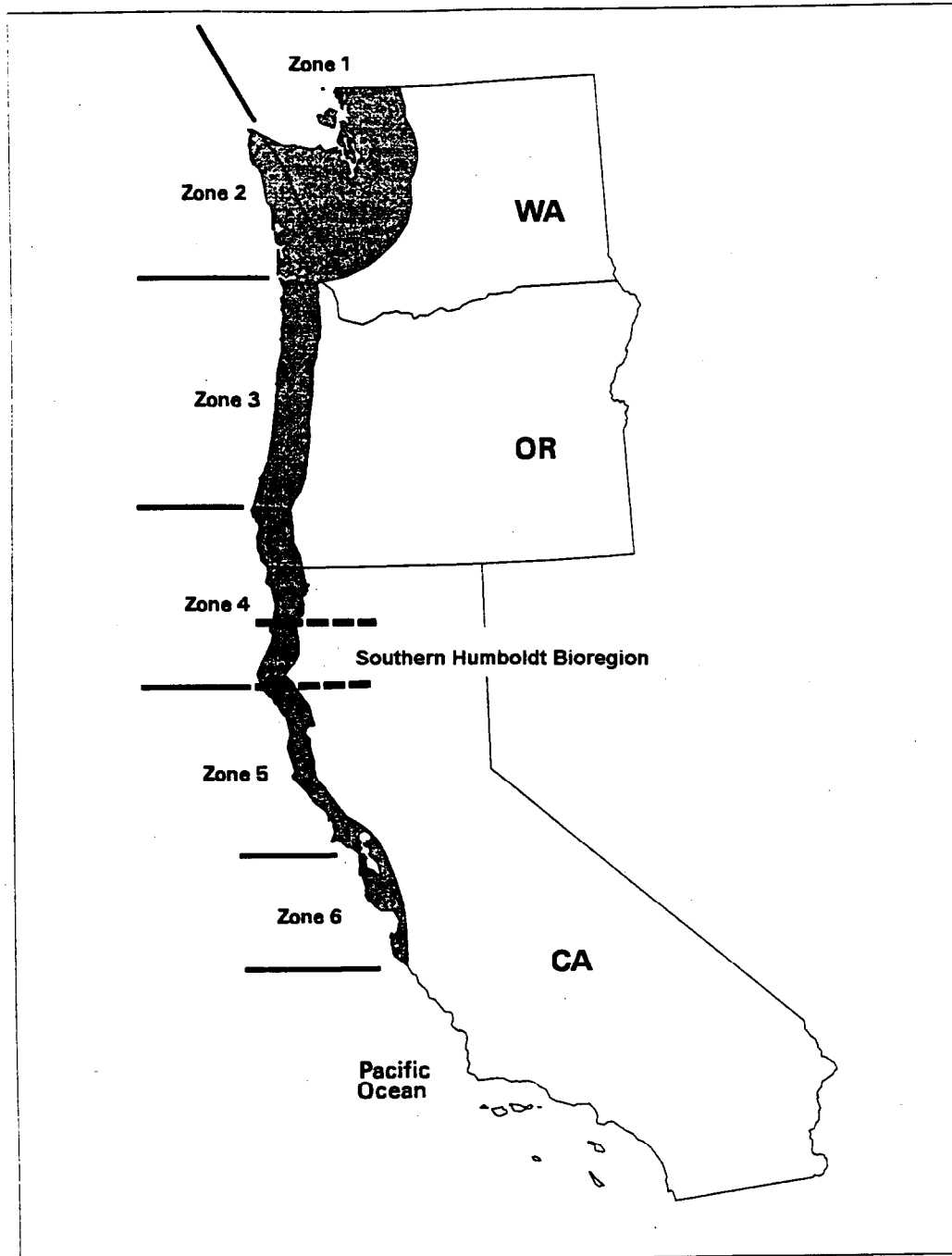


Figure 8. Map of the six Marbled Murrelet Conservation Zones (Zones). See text for descriptions.

Figure #2

**Pacific Lumber HCP
Marbled Murrelet
Critical Habitat**

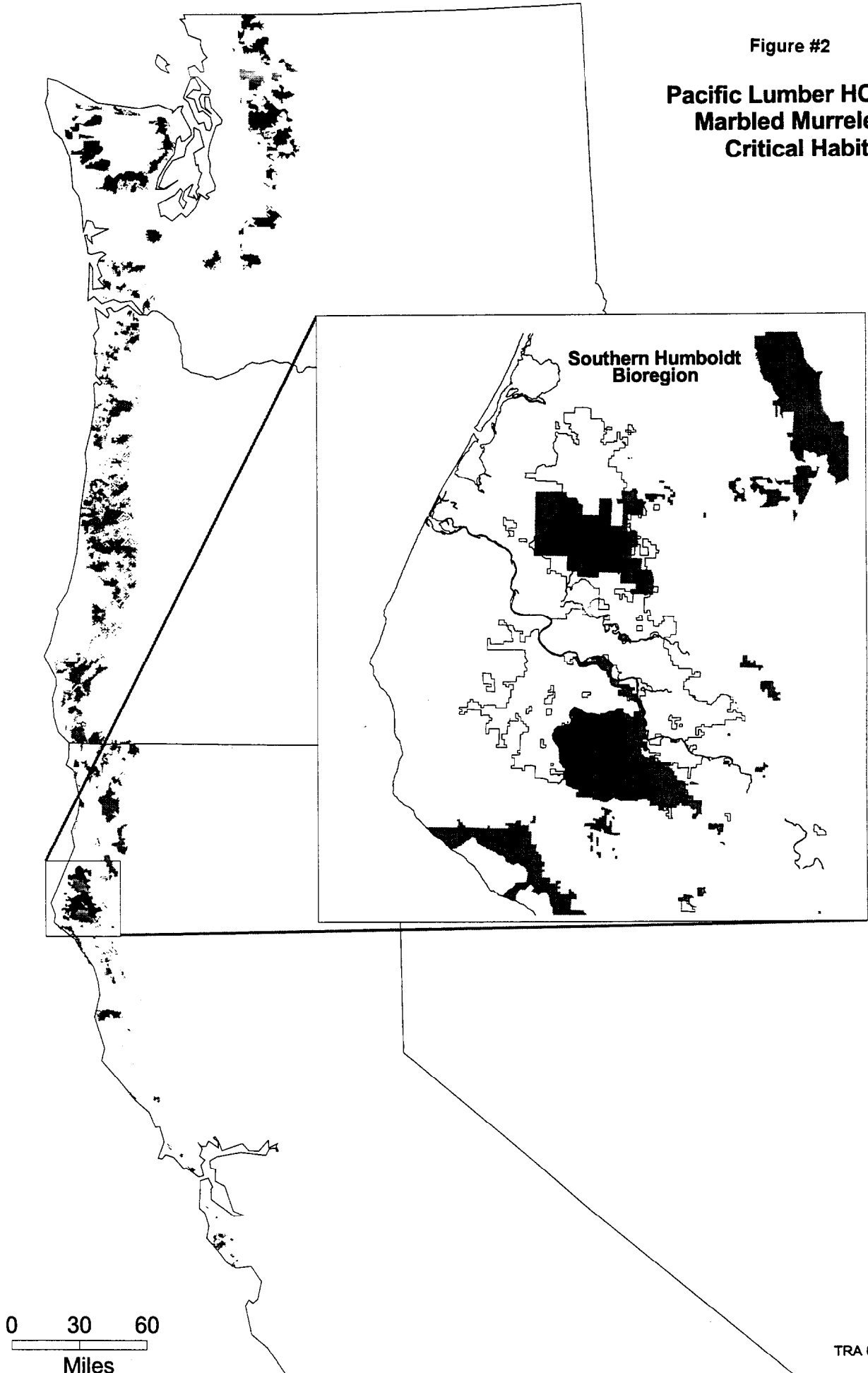


Figure #3A

Pacific Lumber HCP Study Area

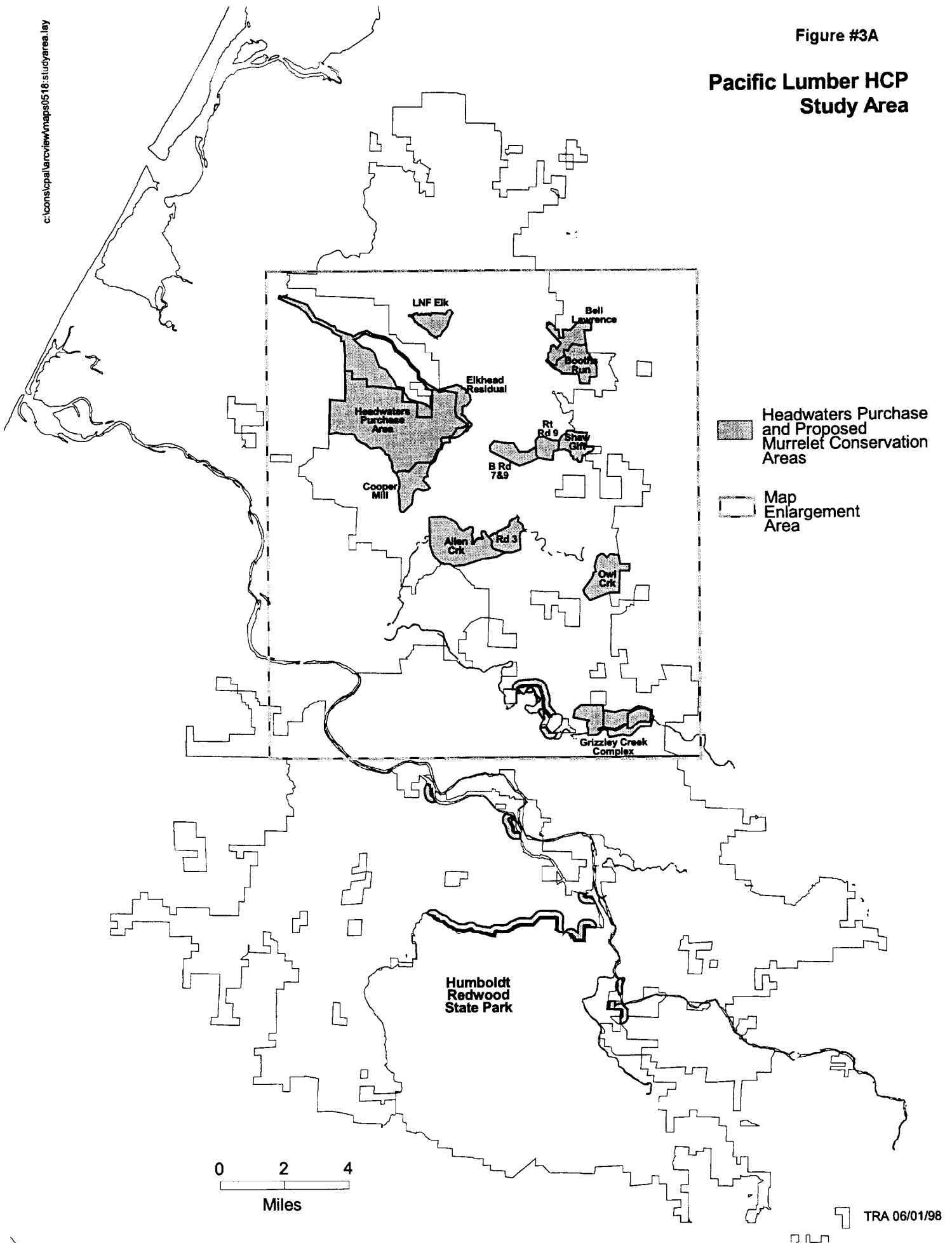


Figure #3B

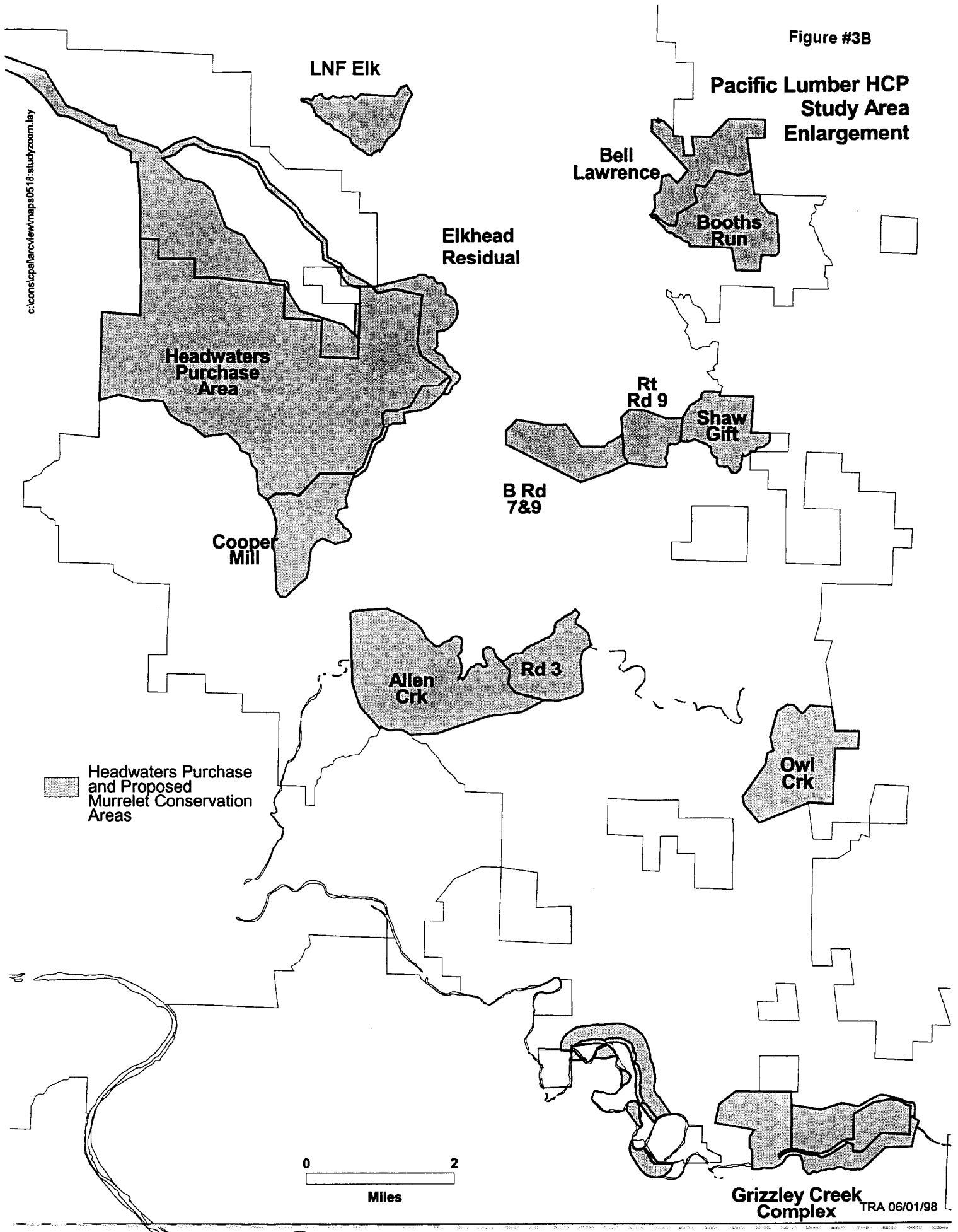


Figure #4A

**Pacific Lumber HCP
Uncut and Residual
Old Growth Redwood**

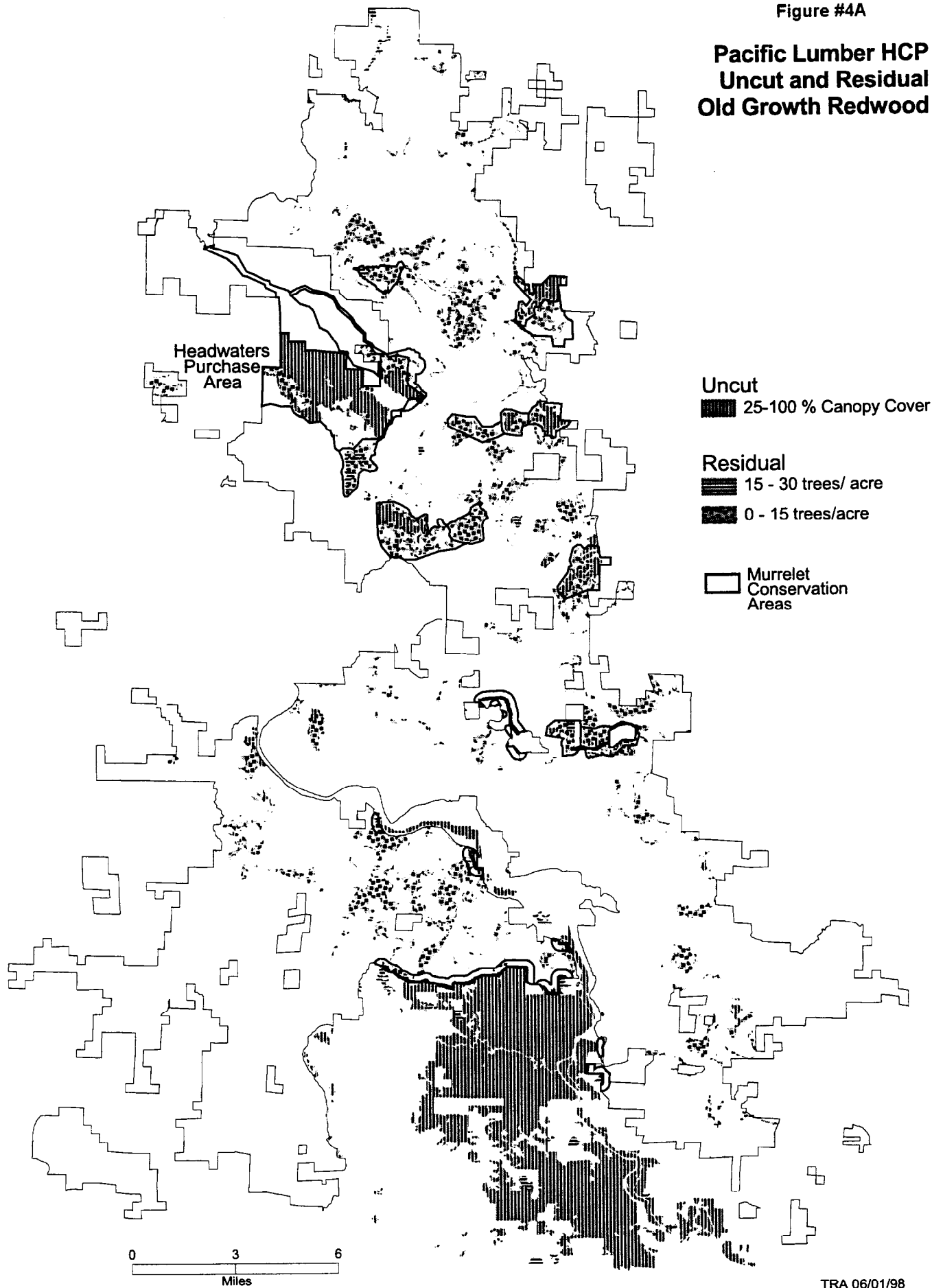
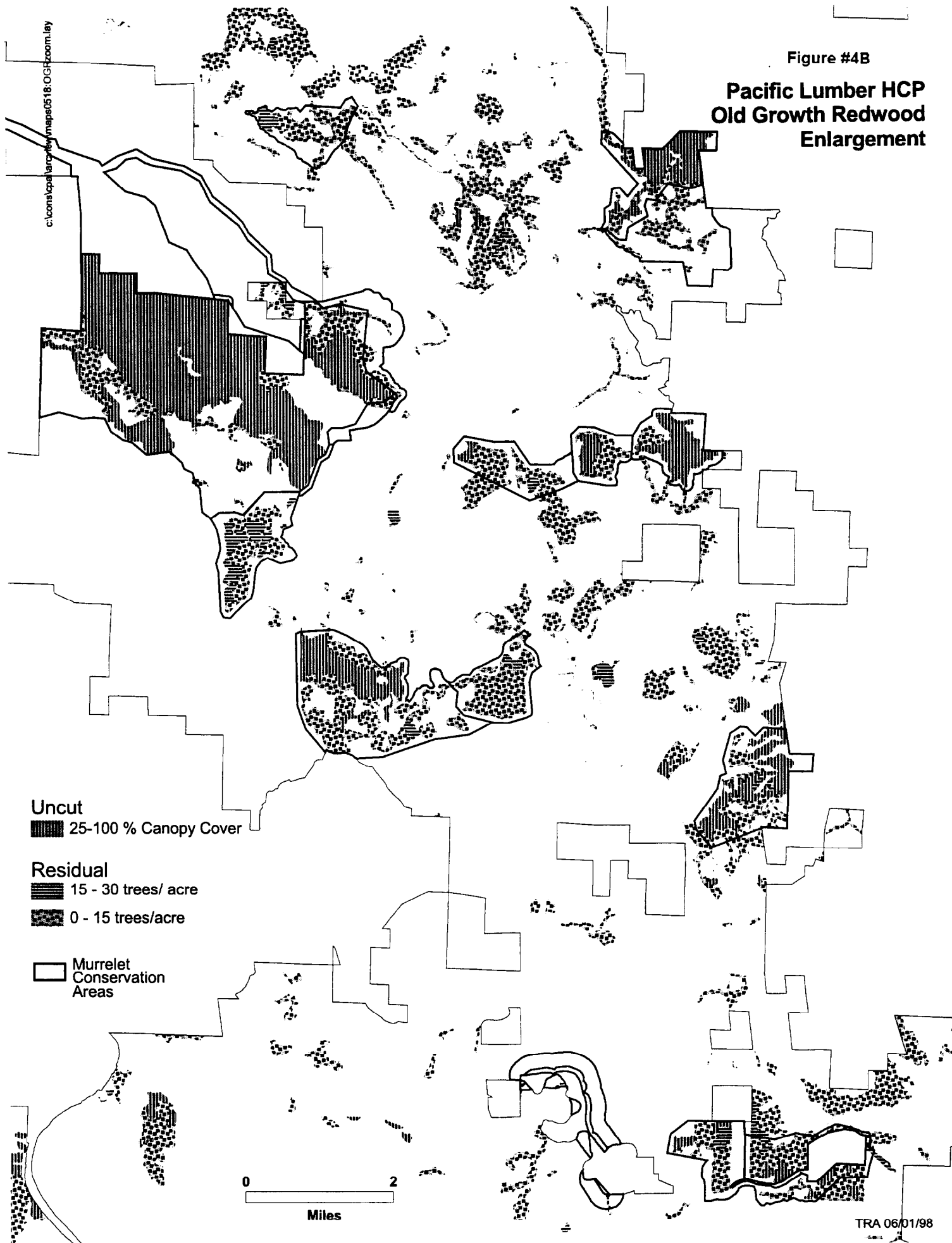


Figure #4B

Pacific Lumber HCP Old Growth Redwood Enlargement



Uncut

25-100 % Canopy Cover

Residual

15 - 30 trees/ acre

0 - 15 trees/acre

Murrelet
Conservation
Areas

0 2

Miles

TRA 06/01/98

Figure #5A

Pacific Lumber HCP Old Growth and Second Growth Forest

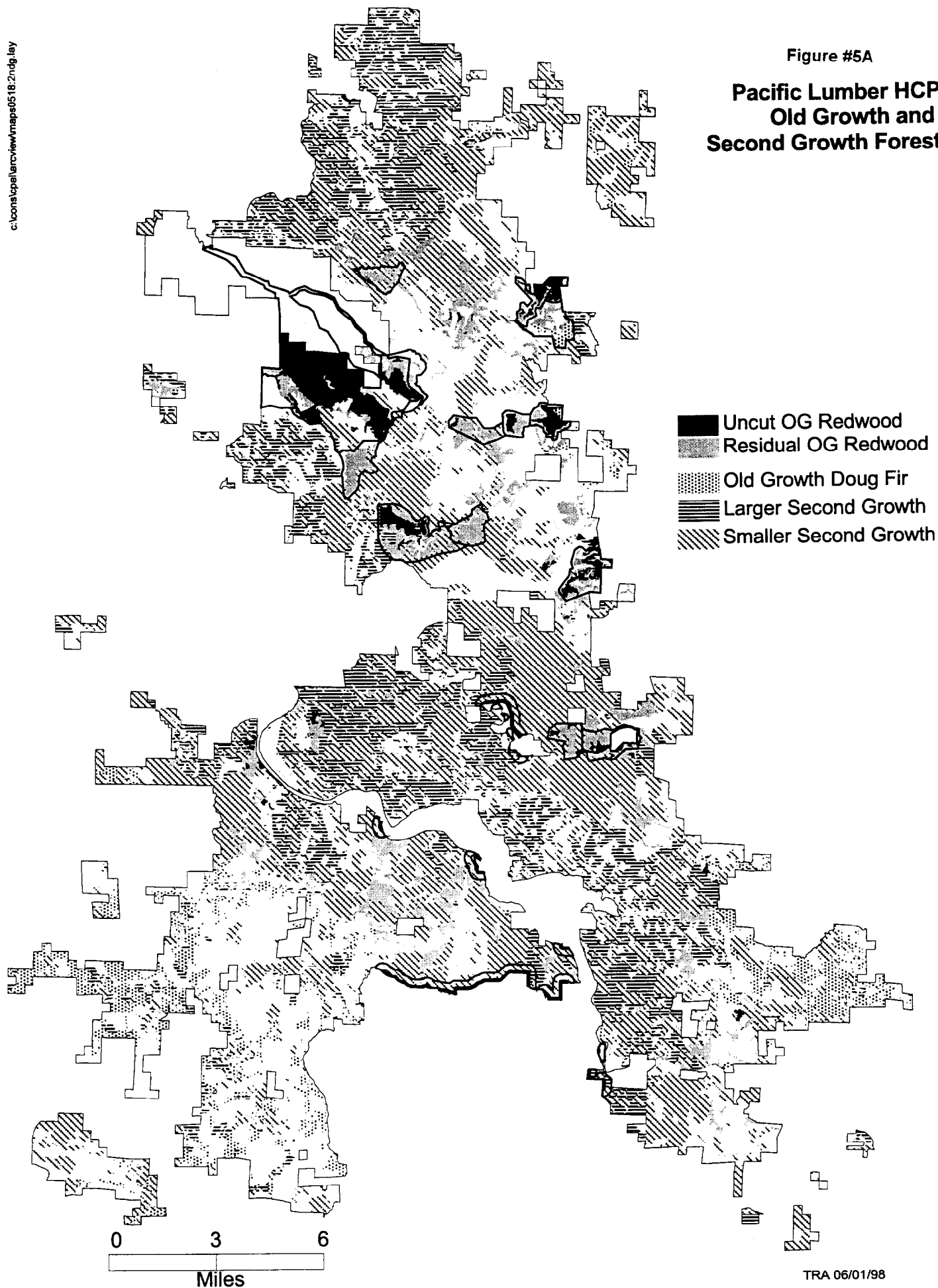


Figure #5B

**Pacific Lumber HCP
Old Growth and
Second Growth Forest
Enlargement**

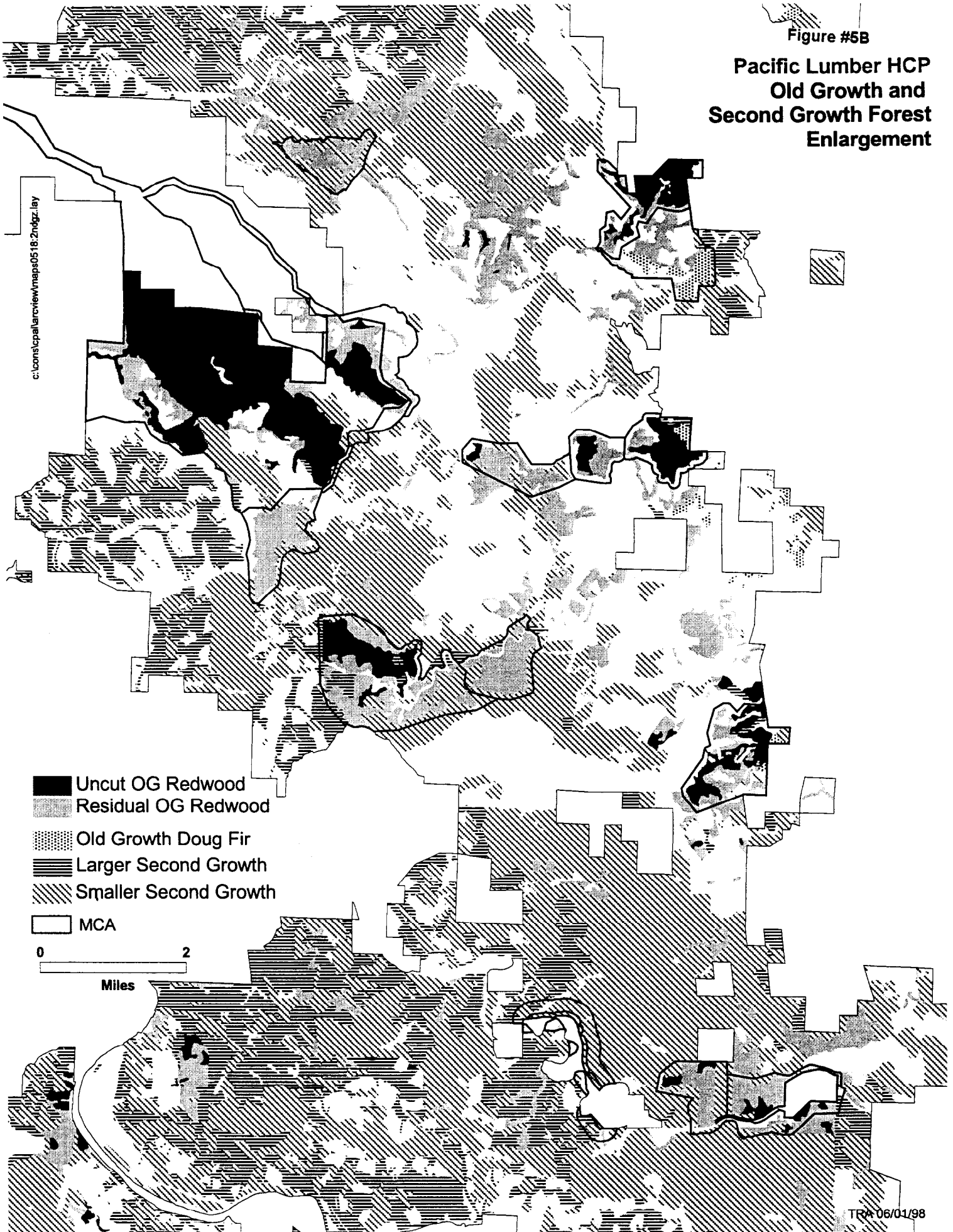


Figure #6

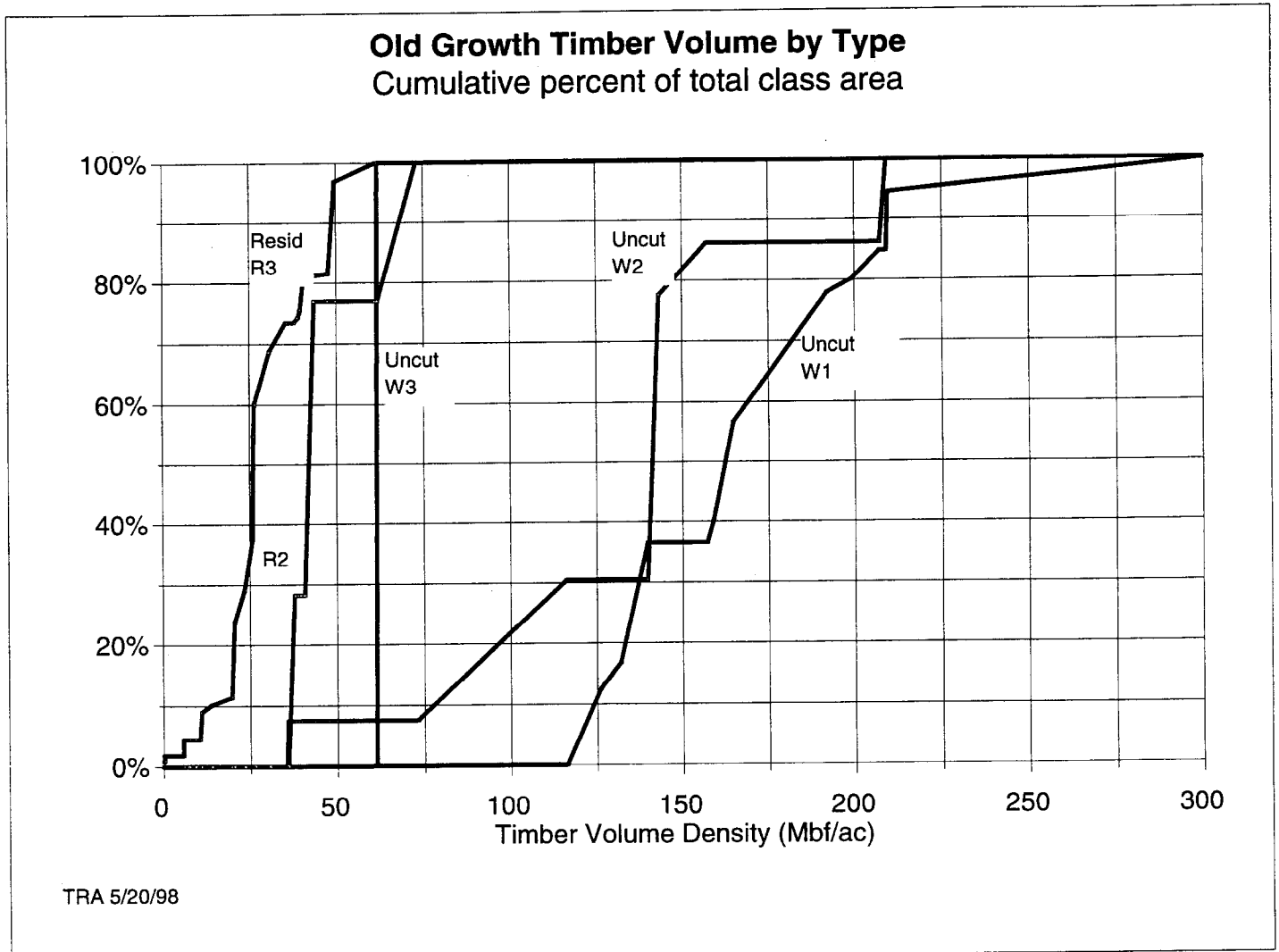


Figure #7A

**Pacific Lumber HCP
Marbled Murrelet
Survey Status**

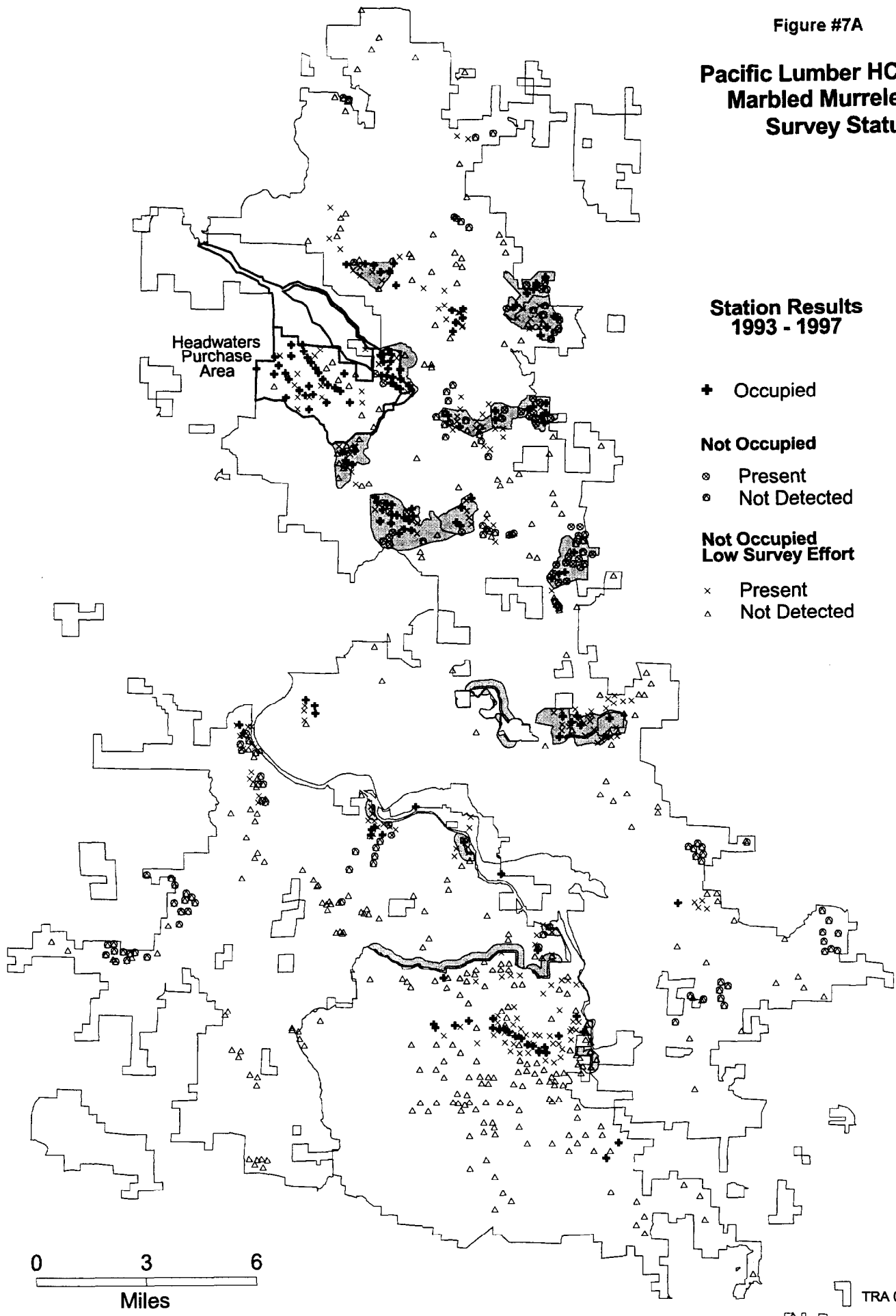


Figure #7B

**Pacific Lumber HCP
Marbled Murrelet
Survey
Enlargement**

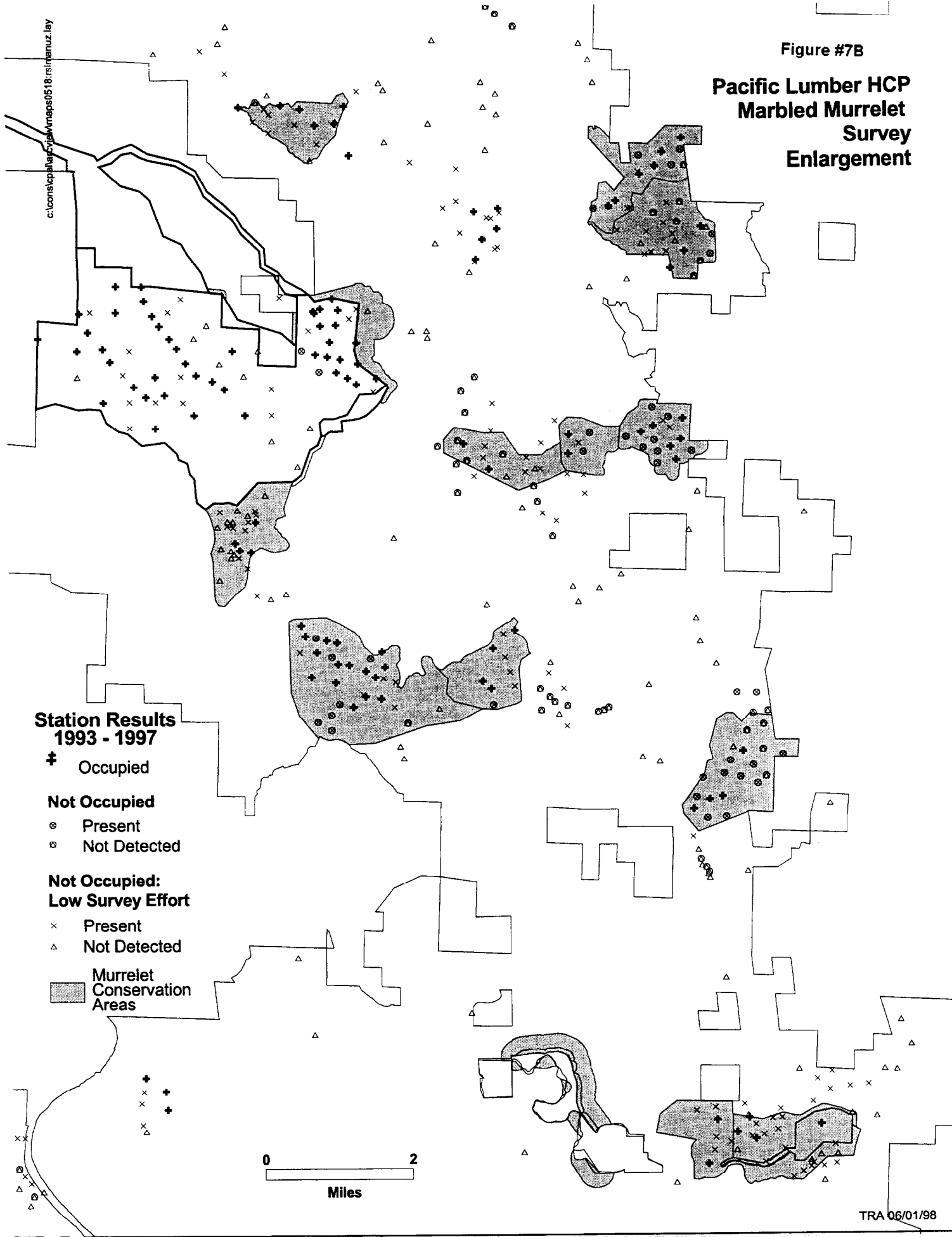


Figure #8A

**Pacific Lumber HCP
Marbled Murrelet
Survey Status
Within 1/2 mile of
Survey Stations**

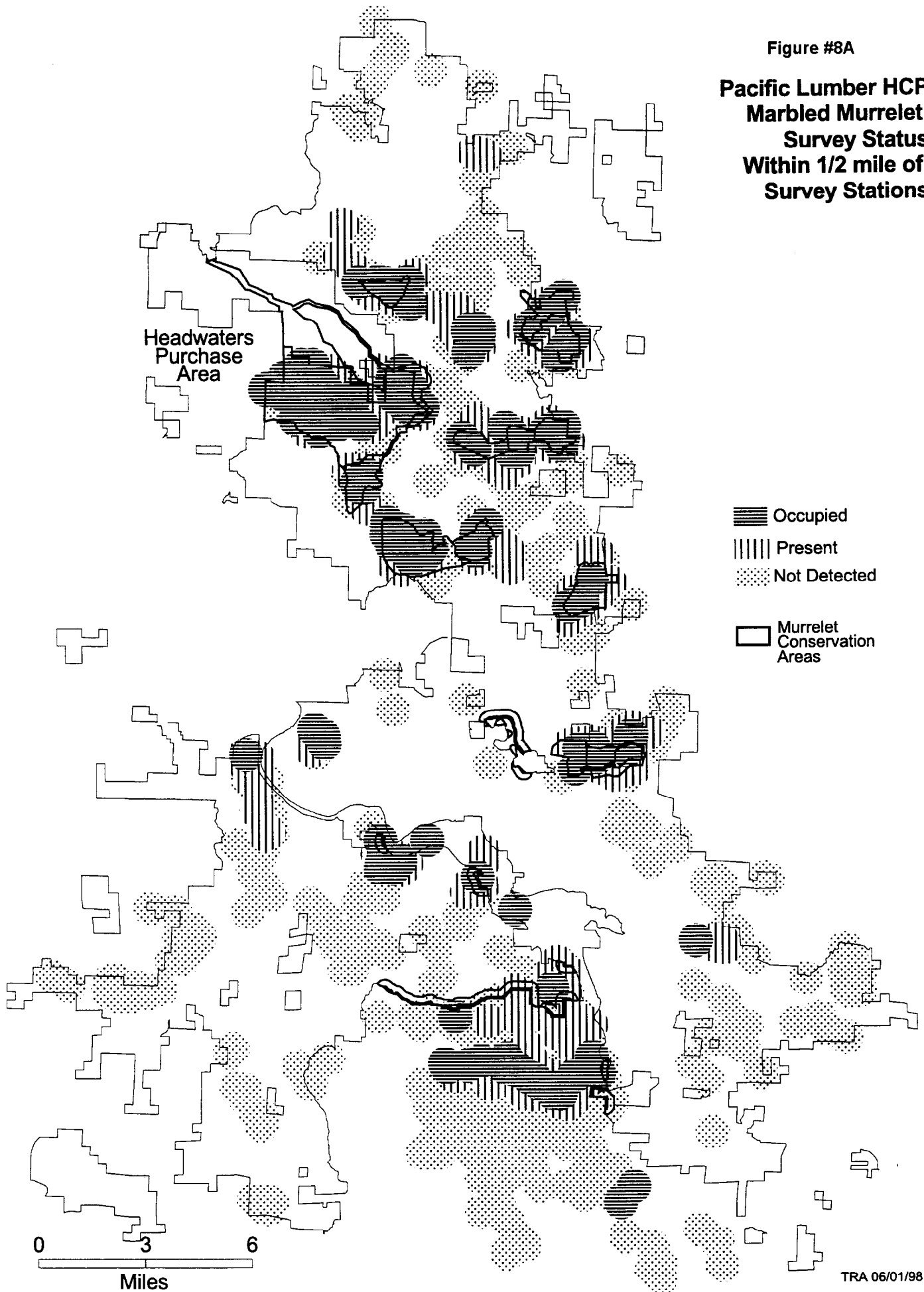


Figure #8B

**Pacific Lumber HCP
Marbled Murrelet
1/2 Mile Survey Status
Enlargement**

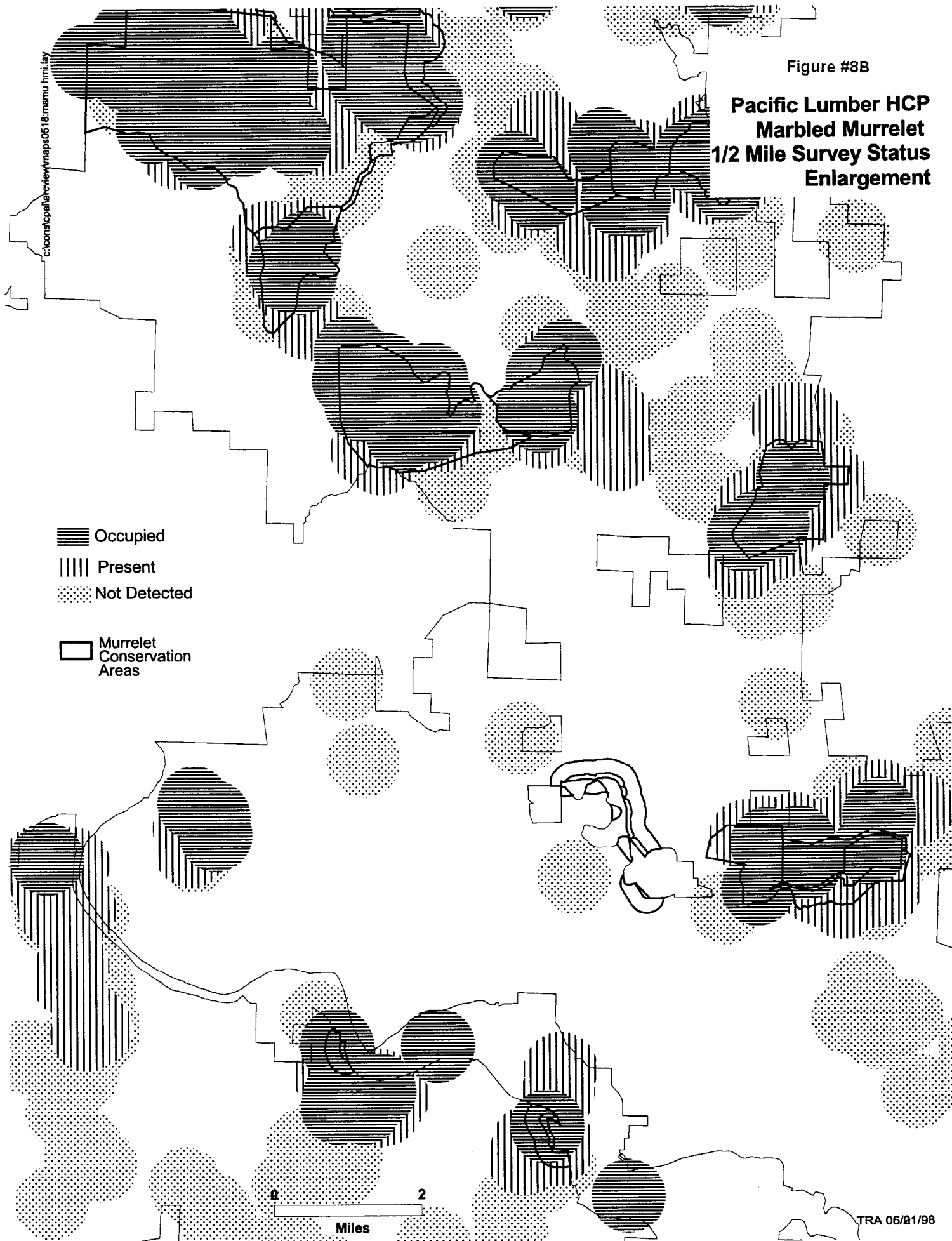


Figure #9

Pacific Lumber HCP

**Relative Frequency of
Occupied Detection in
Marbled Murrelet Surveys**

